2020

Cost and Variations in Trauma Types for Pediatric ER Visits by South Carolina County

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COST AND VARIATIONS IN TRAUMA TYPES FOR PEDIATRIC ER VISITS BY SOUTH CAROLINA COUNTY

BY

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A doctoral project submitted to the faculty of the Medical University of South Carolina
in partial fulfillment of the requirements for the degree
Doctor of Health Administration
in the College of Health Professions

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Acknowledgements

First, I want to thank my mother Isabelle J. Jones for always telling me I can do and be anything I want as long as I maintain my faith, stay focus and be the greatness she saw in me since the day I was born. I say a special thank you to my father Elliott Manigo for the many ways he made me smile with his stories and jokes after long days of research. To my sweetheart George Hill, I am grateful for your support, patient, and encouragement through this entire process. Words cannot express how much I appreciate my mentor Dan Martin for his wisdom and guidance for helping me keep my eyes on the prize. Dr. James Zoller, thank you for planting the seed of encouragement to start the DHA program years before I thought it was even possible. Thanks to my Claflin University undergraduate professor and mentor Dr. Kia Hasan for encouraging me from the very beginning to just do it, get started and never stop until I accomplish my goals. Dr. DaNine Fleming, I will forever be grateful for your unconventional guidance and support that has been a major influence toward accomplishing this goal.

This has been an unforgettable journey, I could not have done any of it without my brilliant committee members Dr. Kit Simpson (chair), Dr. Daniel Briton and Dr. Kathryn Cristaldi King. A very special thank you goes to Marshall Chew for helping me every step of the way with my data analysis, he is truly a data superhero. Dr. Jillian Harvey you have been a great leader, motivator and listening ear through it all. To my DHA cohort and the best support system, we started the program as classmates, but we ended as forever friends and supportive colleagues. Last but not least to my best friend of over 25 years Dequanda Sanders, words cannot begin to express the gratitude I have in my heart for you. Dequanda you have been there for me through it all, the highs and the lows, the late nights and early mornings and times when I needed that extra motivation to push through. “We did it” and I am extremely proud to share this accomplishment with you. To my overall network of family and friends who supported me along this journey I simply say “Thank You” to each and every one of you for helping me realize my dream of getting my doctorate degree. I am proud to join the ranks of my fellow MUSC College of Health Professions Doctor of Health Administration Alums.

Abstract of Dissertation Presented to the
Medical University of South Carolina
In Partial Fulfillment of the Requirements for the
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Abstract

Children between the ages of 0 to 19 are treated in South Carolina emergency rooms (ER) and hospitals for unintentional injuries at an alarming rate which contributes to high medical cost and high mortality and morbidity rate. The objective of the study is to examine ER visits and hospital discharge data for pediatric patients in South Carolina by county to identify trauma types for unintentional injuries, cost, distribution by high-risk populations and by rural or urban classification to determine appropriate interventions. This is a quantitative study using retrospective analysis of archival data from ER visits and hospital discharge data for South Carolina by county for ages 0 to 19. HCUP databases and ICD-10 E-codes is used to identify study population for years 2016, 2017 and 2018. The mean and standard deviation for total charges and ER payments remained static over the three-years. Medicaid (55.1%) was the top payor across all payors. Males represented over 55% for each year studied. Blacks (48.2%) had a higher rate of injury events than all other race. The most common injury events were poisonings 10,467 (25.4%), natural/environmental 9,531 (23.1%) and falls 7,702 (18.7%). Counties with the highest risk percentage and most frequent injury events were Chester, Cherokee, Orangeburg, Williamsburg, Fairfield, Beaufort, and Georgetown counties.

Key words: unintentional injury, childhood injury, pediatric emergency room visits, preventable child injury and injury cost.

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CHAPTER I INTRODUCTION

1.1 Background and Need

Childhood injury is the leading cause of death for children (WHO, 2008). Throughout the world, almost one million children die of an injury each year and almost every one of these tragedies is preventable (Safekids Worldwide, 2019). Child injury represents one of the most immediate public health threats, resulting in the death of nearly 2,000 children under age 14 every day around the world (Sleet, 2018). Every year the number of childhood injuries, deaths, and nonfatal injuries increases affecting the lives of between 10 and 30 million more globally (Borse et al., 2008). Children are dying at an alarming rate every day from childhood injuries. It is a major public health problem that continues to threaten the health of all children around the globe. In 2011, the World Health Organization (WHO) estimated that over 630,000 children under the age of 15 were killed by an injury. An estimated one in four children will be injured severely enough to require medical attention annually (WISQARS, 2018). For every injured child who dies, there are several thousand children who live on with varying degrees of disability which contributes to the increasing child mortality and morbidity rate (Sleet, 2018) in addition to high medical cost.

Childhood injuries are classified as unintentional or intentional and by mechanism or cause of injury. Injuries due to assault or self-inflicted violence such as suicide and war are classed as intentional injuries. Accidental injuries that occur due to traffic accidents, burns, falls, drowning, suffocation, poisonings and sports-related injuries are classed as unintentional injuries. Injuries are also categorized as fatal if death occur or is imminent and nonfatal if not resulting in or capable of causing death. The most common cause of injuries to children age 0-19 by mechanism or cause are unintentional injuries (Sleet, 2018). Nationally, more than 12,000

children aged 0-19 years die each year from fatal unintentional injuries and more than 9.2 million are treated in emergency rooms for nonfatal injuries (CDC, 2012). According to the Centers for Disease Control and Prevention (CDC) unintentional injury is the number one cause of death of children age 0-19.

Preventable injuries top the list as the number one killer of kids in the United States (US) (CDC, 2012). Unintentional injury is the leading cause of morbidity and mortality among children in the US. About 33 children ages 0-19 die every day from a preventable injury which is more than the number of children who die from all diseases combined (Sleet et al., 2012). In 2016, for every unintentional injury death to those ages 0-19 there were approximately 33 hospitalizations, 1053 emergency department visits and 450 doctor visits (WISQARS, 2018, Sleet et al., 2012). Injury is a common and costly childhood problem, accounting for approximately 15% of medical spending from ages 1 to 19 (Miller et al., 2014). Children injured in preventable injuries may face disabilities and chronic pain that limits their ability to perform age-appropriate everyday activities over their lifetime (NCHS, 2000). These injuries also impact the entire family unit including parent's lifestyle and quality of life for other children in the home. The frequency, severity, potential for death and disability, and costs of unintentional injury make it a leading problem with significant economic impact on healthcare spending for pediatric children. In 1996 unintentional childhood injuries resulted in an estimated $14 billion in lifetime medical spending, $1 billion in other resource costs, and $66 billion in the present and future associated work losses (Miller et al., 2014). Decades later in 2006, the estimated cost of unintentional childhood injuries approached $300 billion annually in the US (WISQARS, 2008, Borse et al., 2008).

Unintentional injuries are a major cause of disabilities, which can have a long-lasting impact on all facets of children's lives: relationships, learning, and play. Among those children who live in poverty, the burden of injury is highest (Sleet, 2018). A large proportion of these injuries (for example, drowning, burns, falls, car accidents) occur in, near or around the home (NCIPC, 2016) in the child's local community. Injuries vary by cause, age, race, gender, and location. Childhood injury is a public health problem that requires effective prevention strategies to decrease child mortality and morbidity rate and reduce the high medical cost associated with Emergency Room (ER) visits and hospitalization (NCIPC, 2016). The collective goal of parents and child advocacy organizations is to prevent harm to children. Research to better understand variations in trauma type for pediatric ER patients can provide opportunities to develop targeted prevention strategies to reduce childhood injuries and decrease overall medical cost associated with injuries.

1.2 Problem Statement

Modest public health and environmental efforts addressing child injuries began in the 1940s and 1950s, but it was not until the 1960s that concentrated efforts in the U.S. and elsewhere were made to collect and use data, formulate policies, and implement best-practices to reduce childhood injuries (Sleet et al., 2012). Government, public, private partners, non-governmental organizations (NGOs), and foundations are increasingly aware of the economic strain childhood injuries place on society. In response, they are strengthening data collection systems, identifying risk and protective factors, implementing and evaluating interventions, and disseminating evidence-based prevention strategies for nationwide adoption (Sleet, 2018). A comprehensive research study on the cost and variations in trauma types for pediatric patient's ER visits by county generates inclusive data that can be used to implement evidence-base best-

practices in specific demographic areas and high risk populations for more precise childhood injury prevention strategies and interventions.

1.3 Research Question and Hypotheses

The purpose of this study is to examine cost and variations in trauma types for pediatric ER visits by county using SC 2018 hospital discharge data. This quantitative study analyzes the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes, International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes and External Cause-of-injury coding (Ecoding) from SC 2018 hospital discharge data for pediatric ER visits. Detailed analysis of the ICD-10 codes and Ecoding will produce empirical data to categorize specific population subgroups and high-risk populations by injury type for SC counties. These findings can identify high-risk geographic areas and may be used to implement interventions necessary to reduce incidents in targeted areas or counties in SC.

1.4 Population

The pediatric population is defined as infants, children, and adolescents age 0 to 19. The study includes all children age 0-18 who visited a SC hospital ER for injuries classified as unintentional (fatal and non-fatal). The study will identify the answers to the following research questions:

1. What was the overall SC rates of potentially avoidable events in 2018?
2. Do these types of events vary for rural and urban counties?
3. What is the overall expected insurance or parental payments for these events in 2016, 2017 and 2018?
4. Which types of events may be most likely to be modifiable by educational or regulatory interventions?

5. Which are the 5 counties that should be targeted first in any rollout of interventions? And why should they be targeted?
6. What is the estimated savings if we could reduce these accidents by 10%? And to whom would the savings accrue?

CHAPTER II SCOPING LITERATURE REVIEW

2.1 Research Overview

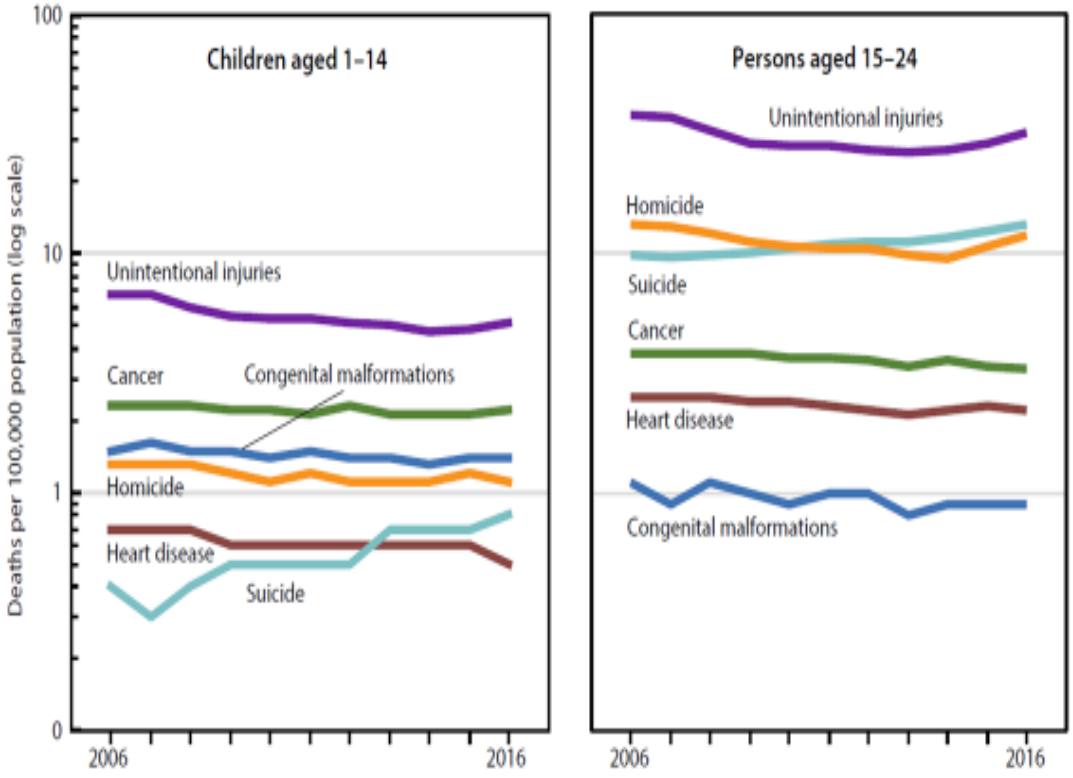
The health of children has changed significantly during the past 50 years. Widespread immunization programs have nearly eliminated the threat of infectious diseases, such as polio, diphtheria, and measles. However, a major public health problem that continues to threaten the health of all children has no vaccine, it is the threat of childhood injuries. Child injury represents one of the most immediate public health threats, resulting in the death of nearly 2000 children under age 14 every day around the world (Sleet, 2018). The Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System (WISQARS) reported to the National Center for Injury Prevention and Control that each year, injuries to U.S. children 0-19 years of age result in an estimated $94 billion in lifetime medical and work-loss costs (WISQARS, 2008).

Modest public health and environmental efforts addressing child injuries began in the 1940s and 1950s, but it was not until the 1960s that concentrated efforts in the U.S. and elsewhere were made to collect and use data, formulate policies, and implement best practices to reduce childhood injuries (Grossman, 2000; Sleet, D. et al., 2012). Sleet conducted a compilation study to review publications related to the burden of childhood injuries, interventions applied around the world, and the use of theoretical approaches and program evaluation. Publications on childhood injury steadily grew in both the number of articles published per year and as a proportion of all publications on children's issues during that 31-year period. Since that time, publications of research articles, books, and commentaries on child injury and prevention have mushroomed (Sleet, David A., 2018).

Overtime, the threat of injury to children has become a costly and serious danger to child well-being in the US and abroad (Yao et al., 2019). Childhood injuries have emerged as a leading global public health problem with direct and indirect economic burdens related to premature morbidity and mortality of the children (Sleet, David A., Ballesteros, & Borse, 2010). Moreover, injuries account for approximately 15 percent of medical spending for children and youth ages 1 to 19, making these injuries a costly childhood problem (Miller et al., 2000). Injuries to children causes a significant health and economic burden, generating an estimated 50 billion in lifetime costs annually (Ferguson et al., 2013). Injuries as a major public health problem increase disability and death, and also represent a great economic burden (WHO, 2008) to the child's household unit as well as the need for urgent execution of pediatric care delivery. Unintentional injuries (UI) have become a hot topic in the field of public health because of its high disability and mortality among children (Birgul et al., 2013).

Large numbers of children and youth over the world are killed as a result of UI and are estimated to represent 90% of 950,000 annual deaths, which makes UI the primary cause of death for children worldwide (WHO, 2008). Compared with adults, children are a high-risk group for UI (Lao, Gifford, & Dalal, 2012). Liu et al. found that child deaths caused by UI is one of the slowest declines from 2000 to 2013, and approximately 0.324 million children died caused by UI in 2013 (Liu et al., 2015). Mortality data from the National Center for Health Statistics (NCHS): National Vital Statistics System (NVSS), show that UI continue to rank higher than any other illness or disease in the US (NCHS, NVSS, 2017). Figure 1 shows the death rates among children aged 1–14 years and persons aged 15–24 years, by leading causes of death in the United States for 2006–2016**.**

Figure 1. Leading Causes of death: Children aged 1-14 years and person aged 15-24 years



NOTES: Unintentional injuries is accidents. Congenital malformations is congenital malformations, deformations, and chromosomal abnormalities. The majority of suicide deaths in children aged 1-14 years were among those aged 10–14 years.

SOURCE: NCHS, *Health, United States, 2017*, Figure 23. Data from the National Vital Statistics System (NVSS), Mortality.

2.2 Injury Classification

"Injury is defined as damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of such essentials as heat or oxygen" (Healthy People 2010, 2012).

"Injury" Versus "Accident"

"Accident" is often used to mean an unintentional event that produces, or has the potential to produce, an injury. Sometimes, the word "accident" is used synonymously with "injury." However, many experts in public health believe that widespread use of the term

"accident" has not only caused semantic confusion but has inhibited efforts to reduce injuries (Espitia-Hardeman & Paulozzi, 2005). What were referred to for decades as "accidents" we now refer to as "unintentional injuries." Injuries are not the result of accidents or acts of fate; child and adolescent injuries result from events that are both predictable and preventable (Sleet, Ballesteros, & Borse, 2010).

2.3 Unintentional Injuries

Espitia-Hardeman and Paulozzi (2005) defined unintentional injuries as: physical damage to the body, damage resulting from excessive energy applied to the body (e.g., physical, radiant, electric, thermal); or from exposure to external agents (e.g., poisons, chemical); or from the absence of essentials (e.g., warmth, oxygen) or the application, exposure, or deprivation not done deliberately to oneself or by another person (Espitia-Hardeman & Paulozzi, 2005).

The top five causes of unintentional injuries published by the WHO are traffic accidents, drowning, poisoning, burns, and falls (Lao et al., 2012). Unintentional injuries account for about two thirds of all injury deaths in the United States. Almost half are attributable to motor vehicle-related incidents. The top three of the most dangerous areas and causes for concern for children are motor vehicles, bicycles, and pools. A considerable amount of energy in the past decade has been spent on the issue of motor vehicle passenger injuries to decrease the amount of motor vehicles-related deaths (Zonfrillo et al., 2018).

2.4 Mechanism of Injury

Trauma starts with the transfer of energy to the body from an outside force. The outside force occurs by various mechanism which drives the injury sustained. Mechanism of injury describes the source of the energy transfer that results in physical or physiological harm to the body. Examples of mechanisms of injury include falls, motor vehicle traffic crashes, burns,

poisonings, and drownings (CDC & NCHS, 2019). Table 1 was adapted from Mohan and Romer 1998 Accidental mortality and morbidity in developing countries in, "The Epidemiological Approach" (Espitia-Hardeman & Paulozzi, 2005). This table illustrates the mechanism of injury matched with the place of injury occurrence. Shaded boxes indicate locations where the injury occurs most often.

Table 1. Unintentional Injuries by Mechanism and Place of Occurrence

Mechanism of Injury	Place of Occurrence				
	Home	Sports/ Leisure	Work-places	School Facilities	Public Places
Burns/Scalds From electrical appliances, cooking mishaps, cooking stoves with open flame, radiators, home fires, fireworks	■		■		
Cuts/Lacerations Toys, sports, playgrounds, furniture, household gadgets, gadget blades, occupational hazards	■	■	■	■	
Drowning At pools and beaches or from floods, falls into ponds and wells, water transport	■	■	■	■	■
Impact Injury Falls from rooftops, windows or furniture; falls related to agriculture, construction, recreation, sports, or transportation (automobiles, cyclists, pedestrians, motorcyclists)	■	■	■	■	■
Electric Shock From household gadgets, toys, and substandard or hazardous wiring; improper use of and substandard electrical gadgets	■		■		
Poisoning From medicines, household chemicals, cooking fuels, seeds	■		■		
Suffocation/Asphyxia From infant and toddler furniture, clothes and toys, plastic bags, swallowing of seeds or toys	■				
Firearms Unintentional use	■	■	■	■	■
Insect and Animal Bites From dogs, snakes, scorpions, etc.	■	■	■	■	■

Adapted from: Mohan D, Romer J. Accident mortality and morbidity in developing countries. In: *The Epidemiological Approach*. New York, NY: Oxford University Press; 1998.

2.5 Patterns of Unintentional Injuries: Related Deaths

Researchers have studied injuries to better determine patterns in hopes of identifying prevention programs to implement crucial interventions, parental education and legislative policies. To study injury events to identify injury patterns, the CDC Childhood Injury Report "Patterns of Unintentional Injuries among 0-19 age in the United States 2000-2006" used data

from the National Vital Statistics System and the National Electronic Injury Surveillance System. The report provided and overview of all Injury Program of unintentional injuries related to drowning, falls, fires or burns, transportation-related injuries, poisoning, and suffocation, among others during the period 2000-2006. The results were presented by age group and sex, as well as the geographic distribution of injury death rates by state. A synopsis (Borse & Sleet, 2009) of the finding concluded:

- Males had higher injury death rates than females
- Injuries due to transportation were the leading cause of death for children
- The leading causes of injury death and risk differed by age group, race, and location depending upon the cause of death.

2.6 Leading Cause of Unintentional Injury Deaths

Multiple studies concluded findings contributing motor vehicle traffic-related deaths as the leading cause of unintentional injury deaths among those between 0-19 years of age. Suffocation was also included in CDC report because it was the leading cause of injury death in the U.S. population for children less than 1 year of age (Borse & Sleet, 2009). The two tables below provide a visual depiction of the CDC data where the shaded boxes indicate type of injury by age groups and weighted percentage of injuries that occur most often. Table 2 shows the leading causes of unintentional injury deaths by age group using the CDC External Cause of Injury Mortality Matrix. Suffocation was ranked first for children less than 1 year of age, while MVT-related deaths were first for all other age groups. Table 3 shows the leading causes of unintentional injury deaths by age group using the CDC Modified Matrix which provide a more detailed analysis of injury cause. In the Modified Matric suffocations was still ranked first for

infants. However, drowning leading cause of death for children 1 to 4, and MVT-Occupant ranked first for the older age groups.

Table 2. Leading Causes of Unintentional Injury Death among Children 0to 19 Years using the External Causes of Injury Mortality Matrix, by Age Group, United States, 2000-2005

	Age Group in Years				
Rank	Less Than 1 (n = 5,883)	1 to 4 (n = 10,203)	5 to 9 (n = 7,144)	10 to 14 (n = 9,088)	15 to 19 (n = 40,734)
1	Suffocation 66%	MVT-related 31%	MVT-related 53%	MVT-related 58%	MVT-related 76%
2	MVT-related 14%	Drowning 27%	Other Injuries 15%	Other Injuries 18%	Other Injuries 9%
3	Drowning 7%	Other Injuries 15%	Fires or Burns 13%	Drowning 10%	Poisoning 7%
4	Other Injuries 6%	Fires or Burns 14%	Drowning 13%	Fires or Burns 6%	Drowning 5%
5	Fires or Burns 4%	Suffocation 8%	Suffocation 4%	Suffocation 4%	Falls 1%
6	Poisoning 2%	Falls 2%	Falls 1%	Poisoning 2%	Fires or Burns 1%
7	Falls 2%	Poisoning 2%	Poisoning 1%	Falls 2%	Suffocation 1%

Table 3. Leading Causes of Unintentional Injury Death among Children 0 to 19 Years using the Modified Matrix, by Age Group, United States, 2000-2005

	Age Group in Years				
Rank	Less Than 1 (n=5,883)	1 to 4 (n=10,203)	5 to 9 (n=7,144)	10 to 14 (n=9,088)	15 to 19 (n=40,734)
1	Suffocation 66%	Drowning 27%	MVT - Occupant 22%	MVT - Occupant 26%	MVT - Occupant 41%
2	MVT - Occupant 8%	Pedestrian 15%	MVT - Unspecified 15%	MVT - Unspecified 15%	MVT - Unspecified 28%
3	Drowning 7%	Fires/Burns 14%	Pedestrian 14%	Pedestrian 12%	Poisoning 7%
4	MVT - Unspecified 5%	MVT - Occupant 13%	Fires/Burns 13%	Drowning 10%	MVT - Other 6%
5	Other Injuries 5%	MVT - Unspecified 9%	Drowning 13%	MVT - Other 9%	Pedestrian 5%
6	Fires/Burns 4%	Suffocation 8%	Other Injuries 7%	Other Injuries 8%	Drowning 5%
7	Poisoning 2%	Other Injuries 8%	MVT - Other 6%	Fires/Burns 6%	Other Injuries 5%
8	Falls 2%	Falls 2%	Pedal Cyclist 4%	Pedal Cyclist 6%	Falls 1%
9	Pedestrian 1%	Poisoning 2%	Suffocation 4%	Suffocation 4%	Fires/Burns 1%
10	MVT - Other 0.5%	MVT - Other 2%	Falls 1%	Poisoning 2%	Suffocation 1%
11	Pedal Cyclist 0.02%	Pedal Cyclist 0.3%	Poisoning 1%	Falls 2%	Pedal Cyclist 1%

Source: WISQARS & CDC, 2015

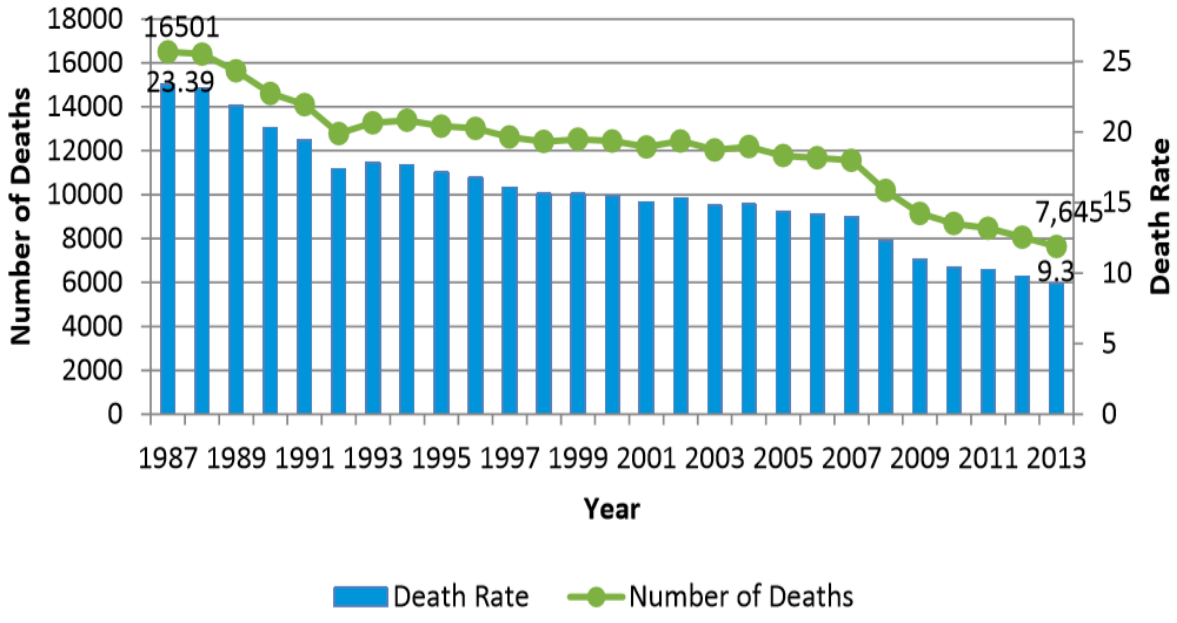
It is notable to point out that similar reviewed articles indicated boys have more unintentional injuries than girls do and consequently the costs in relations to boys are also higher (Lao et al., 2012) which coincide with the CDC report. The World Report of Child Injuries from the WHO also illustration the same trend: boys seem to have more frequent and more severe injuries than girls. It is possible to speculate why boys have a higher risk than girls.

Boys may be more active and adventurous in the environment; and boys engage in more risky behaviors than girls (Turner & McClure, 2003).

2.7 Updated Patterns: Leading Causes of Unintentional injury-related Deaths

Figure 2 shows the unintentional injury fatalities and death rate among children ages 19 and under for 1987 to 2013. According to the graph, the death rate from unintentional injuries declined by 60% from 1987 to 2012. In 1987, 16,501 children ages 19 and under died from unintentional injuries, and the death rate was 23.39 per 100,000 children. In 2013, 7,645 children ages 19 and under died from unintentional injuries, and the death rate was 9.3 per 100,000 children. The number of unintentional injury deaths fell by 53.7% during this time period according the CDC: WISQARS chart below indicated by year.(Safe Kids Worldwide, 2015; WISQARS & CDC, 2015).

Figure 2: Unintentional Injury Fatalities and death rate among children ages 19 and under, 1987-2013



Source: WISQARS & CDC, 2015

The five leading causes and number of unintentional injury-related deaths, by age group for the United States for 2013 is shown in Table 4. MV Traffic injury continue to be the leading cause of UI related death for children between ages 5-19. Suffocation holds consistence with previous reported data as the leading cause for children less than age 1 and Drowning for children age 1-4. While drownings have also moving up as the rank for other age group.

Table 4. The five leading causes and number of unintentional injury-related deaths, by age group, United States, 2013

Rank	Age <1 (n=1,156)	Ages 1-4 (n=1,316)	Ages 5-9 (n=746)	Ages 10-14 (n=775)	Ages 15-19 (n=3,652)
1	Suffocation 979 (84.7%)	Drowning 393 (29.9%)	MV Traffic 342 (45.8%)	MV Traffic 414 (53.4%)	MV Traffic 2,338 (64.0%)
2	MV Traffic 66 (5.7%)	MV Traffic 327 (24.8%)	Drowning 116 (15.5%)	Drowning 93 (12.0%)	Poisoning 587 (16.1%)
3	Drowning 23 (2.0%)	Suffocation 161 (12.2%)	Fire/burn 87 (11.7%)	Other Land Transport 49 (6.3%)	Drowning 241 (6.6%)
4	Environment 19 (1.6%)	Fire/burn 129 (9.8%)	Suffocation 44 (5.9%)	Fire/burn 48 (6.2%)	Other Land Transport 69 (1.9%)
5	Fire/burn 17 (1.5%)	Pedestrian, Other 90 (6.8%)	Other Land Transport 29 (3.9%)	Suffocation 37 (4.8%)	Fall 62 (1.7%)

Source: WISQARS & CDC, 2015

2.8 Unintentional Injury Deaths by Age and Race/Ethnicity

Unintentional injury deaths vary by age, race and ethnicity in certain parts of the country. Just as there is a difference according to income there is also a difference according to race and ethnicity and geographic location. Sleet's analysis of the National Vial Statistics

System for 2013-2015 data shown in Figure 3 is illustrated by the US map below labeled "*Unintentional Injury Death Rates*" illustrating unintentional injury rates were generally high in the southeast and low in New England and the Mideast. States with rates in the highest quartile included AL, AK, AR, KY, LA, MO, MS, MT, ND, OK, SC, SD, and WY. Additionally, there are large differences in childhood unintentional injuries between race/ethnicity and different age groups of children (Lao et al., 2012). Figure 4 shows Sleet's analysis by race and ethnicity for unintentional injury death rates from 2013–2015 were highest among American Indian and Alaskan Native peoples (AI/AN), with the highest rates among AI/AN (63.6) and Black (66.8) infants, and AI/AN 15–19 year old (32.5). Safe Kids Worldwide also report that Native American children 14 years and under have the highest rate of unintentional injury, twice that of white children. African American children have the second highest rate of unintentional injury, 1.7 times that of white children (Safe Kids Worldwide, 2008). These children are more likely to lack health insurance; have difficulty obtaining appropriate and necessary medical care; have lower family incomes, creating significant financial barriers to care; receive care in hospital emergency rooms; and practice fewer safety behaviors. They are less likely to receive lifesaving preventive services. Racial disparities in accidental injury rates appear to have more to do with increased likelihood of living in an impoverished environment than with ethnicity (Safe Kids Worldwide, 2001).

Figure 3: Unintentional Injury Death Rates

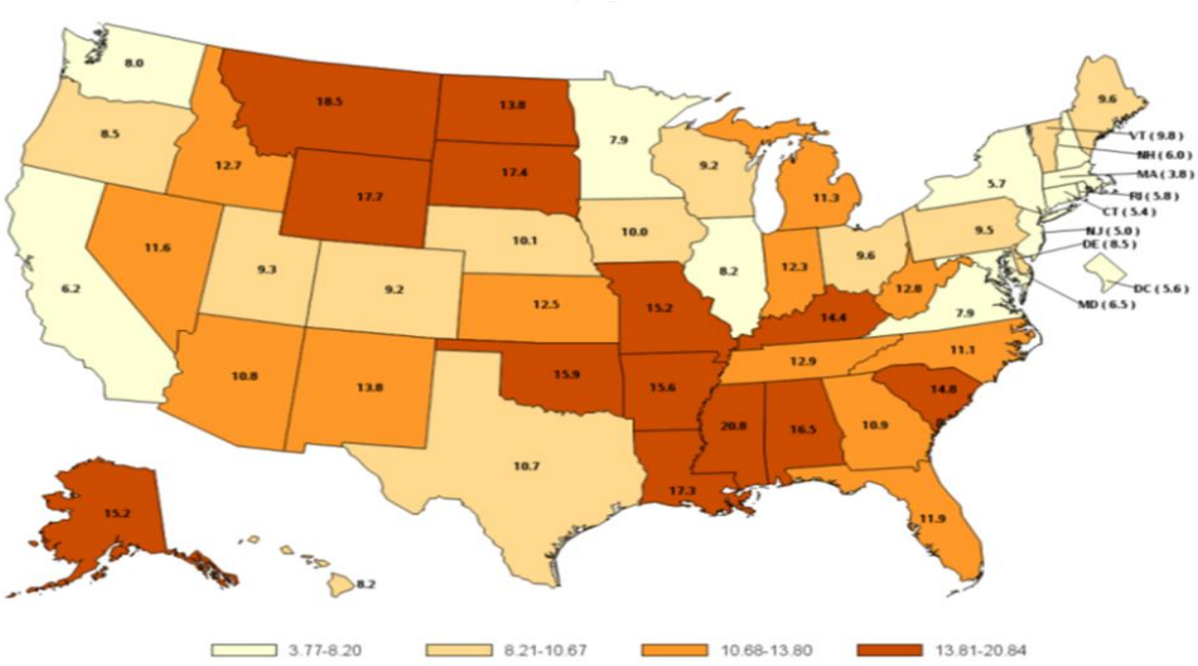
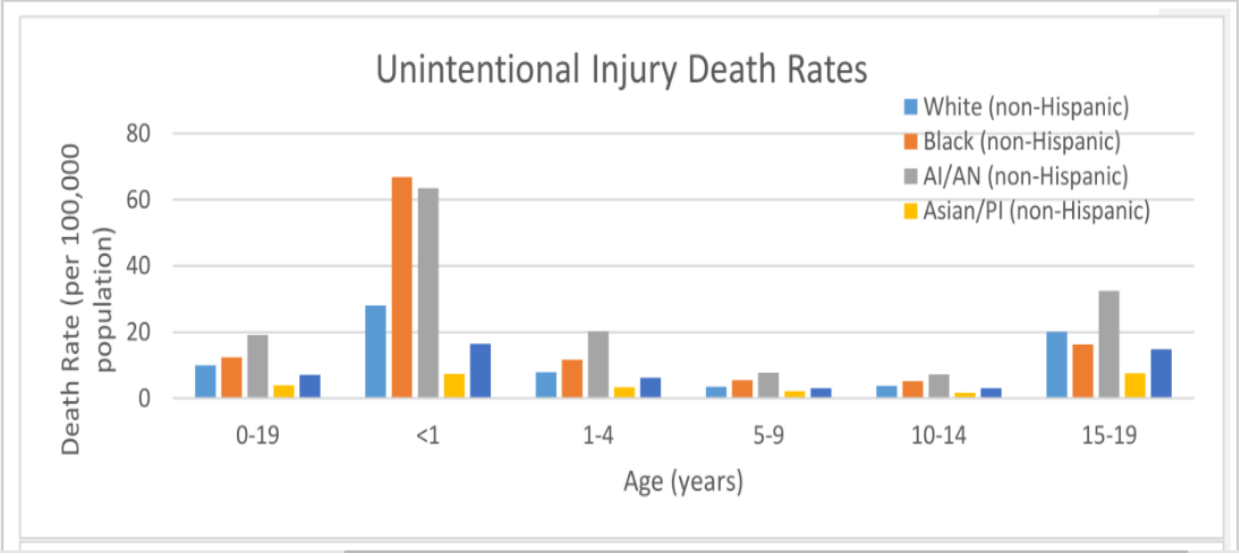


Figure 4: Injury and Violence related death rates (per 100,000 population) among youth ages 0-19 years by intent and race, National Vital Statistics System, United States, 2013-215



Source: National Center for Health Statistics: National Vital Statistics System, 2016

2.9 Changes in Injury Patterns

Understanding injury patterns is critical to injury control as it can provide a picture of the public health and economic burdens that can guide prevention efforts, help identify and reduce risk factors, and increase protective factors (Sleet, 2018). The effects of changes to injury patterns can be a predictor to interventions and forecast the demands of injury care delivery for medical professionals and pediatric practitioners. The effect of environment risk factors and level of risk among children also play a huge part in pattern changes. Childhood development contributes to the age groups differences that are significant in relation to type of injury and causes (Lao et al., 2012). Exploring the physical environment is an important developmental task during infancy and early childhood. Children gradually encounter more and different injury risks at the same time they are developing the perceptual and cognitive abilities to adequately evaluate risky situations (Ballesteros, Williams, Mack, Simon, & Sleet, 2018). Risk-taking is an important part of the lives of children. We do not seek to eliminate all injury risks, but rather to manage and control them (Brussoni, Olsen, Pike, & Sleet, 2012) to minimize the number of childhood injury related deaths.

Childhood injury deaths effect changes in injury patterns which significantly affect the lives and population of children in the United States. There were 73.7 million children in the United States in 2017, which was 1.3 million more than in 2000. This number is projected to increase to 76.3 million in 2030. In 2017 (the latest year of data available at the time of publication), there were fewer children in the 0–5 age group (23.9 million) than in the 6–11 age group (24.7 million) or the 12–17 age group (25.1 million) (FIFCFS, 2017). Public health initiatives can encourage pattern changes through; individual behavior change on the part of children and caregivers, and environmental health can contribute to engineering solutions to

make safe behaviors more likely and to improve the safety of products (Sleet, D. & Dellinger, 2012). However, a deep dive into risk factors associated with childhood injuries should not be absent of analysis as a major contributor of unintentional injuries.

2.10 Unintentional Injury Childhood Risk Factors

Changes in injury patterns, including the likely causes of injury, and a child's ability to respond to risks, are closely related to developmental stages over the life course(Ballesteros et al., 2018). Many risk factors lead to unintentional injuries (Yao, Wu, Zhao, Luo, & Zhang, 2019) at different stages of a child's life and development influenced by their entire ecosystem. Research has been established that the nature and extent of unintentional injury varies widely by race, age, geographic, cultural, urban/rural, and other factors. It is clear from the articles in Sleet's (2018) compilation study explaining unintentional injuries to children do not occur in isolation. They are determined by the choices children and their families make; the quality and design of their environment; the rules and regulations adopted and enforced by their society; the products they use; and by peer interactions and family dynamics at school and at home (Sleet, 2018). Plenty of evidence have proved that childhood unintentional injury is associated with broad factors which are constructed as a multi-level system (Hu, Gao, & Jiang, 2018). Additionally, the quality of housing stock, vehicle safety standards, and the conditions of roads, as well as the social norms present in the child's community and the risks children take, all are contributing factors to injuries (Sleet, 2018).

2.11 Risk Characteristics

The characteristics of children susceptible to injury vary greatly by age, gender, race and socioeconomic status (Yao et al., 2019). The risk factor characteristics that affect the rate of

unintentional injury socioeconomic status general includes, maternal age and parity, gender, and behavior problems (Ballesteros et al., 2018). With the deepening on urbanization and industrialization, as well as changes for environments, children are more likely to be exposed to unintentional injuries (Hu, Gao, & Jiang, 2018). However, the burden of childhood injury is heaviest in the poorer countries with lower family incomes. Poverty is one of the leading contributing factors to high UI incidence, even in high income countries. (WHO, 2008).

Poverty is also considered a predictor of injury. Several factors common to low-income families may increase a child's risk of injury, including single-parent households, lack of parental education, young maternal age and multiple siblings. Despite an overall decline in injury-related death, death rates for children of low-income families continue to increase (Safe Kids Worldwide, 2008). According to Safe Kids Worldwide Injury facts for Children at Risk Overview (2008); children living in low-income homes are twice as likely to die in a motor vehicle crash, 4 times more likely to drown, and 5 times more likely to die in a fire(Safe Kids Worldwide, 2001; World Health Organization, 2008). In all reviewed articles Lao et al, found that children as a risk group shared a higher rate of different kinds of unintentional injuries, especially those aged under 4 years (Lao et al., 2012).

Once children reach the age of five years, unintentional injuries are the biggest threat to their survival. Unintentional injuries are also a major cause of disabilities, which can have a long-lasting impact on all facets of children’s lives: relationships, learning and play. Among those children who live in poverty, the burden of injury is highest, as these children are less likely to benefit from protective measures others may receive (WHO, 2008). At nearly all ages, boys are at a greater risk of preventable injury and death than girls. Factors that are believed to increase their tendency toward risk taking include how they are socialized, types of sports

activities being played, and rougher play. Other children at greater risk for preventable injury include those with developmental disabilities, cognitive and emotional limitations, and attention-deficit hyperactivity disorder (ADHD)(Safe Kids Worldwide, 2001).

2.11a Social-Economic and Environmental Risk Factors

Another important risk factor is unsafe environment settings and facilities. Additionally, lack of safety education and training for children and parents raises the risk of unintentional injuries in children. Children's unintentional injuries are usually affected by economic situations, cultural, habitual and living conditions and have obvious regional and demographical features (Braddock et al., 1991, Lao et al., 2012). Privation environments as an important contributor to childhood unintentional injuries has a significant role in low-and-middle income countries and households. The burden of injury is much greater in low-and-middle income countries: over 95% of injury deaths among children occurred in these countries (World Health Organization, 2008).

As mentioned above, location differences (rural area and urban area) appeared in many of the reviewed articles, which may result in different society setting, facilities and resources in different areas based on their particular development levels (Braddock, Lapidus, Gregorio, Kapp, & Banco, 1991). Consequently, a number of recent studies have focused upon individual- and family-related risk factors related to childhood injury rates (e.g., Brayden et al., 1993; Buck, 1988; Esbensen et al., 1999; Glick et al., 1993) (Freisthler, Gruenewald, Ring, & LaScala, 2008). Differences in family financial conditions, housing, parents' educational levels and parents' relationship in varied locations are social and economic factors which may contribute to children's unintentional injuries (Braddock et al., 1991).

2.11b Rural Vs Urban Risk Factors

Some researchers indicate that the occurrence of children's unintentional injuries in rural areas have associations with child abuse and ignorance of UI (Rivara, 2002), thus producing a malignant interaction of family factors and risk for injury in the poor families. Children living in rural areas are at greater risk from accidental injury-related death than children living in urban areas. These children are especially at risk from drowning, motor vehicle crashes, unintentional firearm injury, residential fires and agricultural work-related injury. Injuries in rural settings occur in remote, sparsely populated areas that tend to lack organized systems of trauma care, resulting in prolonged response and transport times. A short supply of medical facilities, equipment and personnel to treat injuries in rural areas also contributes to increased risk. Minority children living in rural areas are especially at risk from accidental injury related death. Higher injury fatality rates in rural communities are due in part to the high number of farm-related injuries. Children account for 20 percent of all injury-related farm fatalities and represent an even larger portion of nonfatal injuries (Safe Kids Worldwide, 2001).

Because of crowded surroundings, higher urbanization and more hectic lifestyles, urban areas are associated with a higher risk of road traffic injuries, which then lead to larger social and medical costs (WHO, 2008). There is a rich literature in public health, epidemiology, and criminology that suggests certain population (or person) and environmental (or place) characteristics are related to injury outcomes. These include (a) the social capital of neighborhoods (e.g., neighborhood disorganization and impoverishment, (Sampson, Morenoff, & Gannon-Rowley, 2002), (b) neighborhood social controls (e.g., rates of vacant housing related to illegal drug

sales and use, (Green, 1996), and (c) general retail activities that reflect population exposures to problem outcomes (Gruenewald & Reme, 2006).

Conclusive research of low-and middle-income countries, show there is a lack of educational opportunities for both children and parents, poor neighborhood setting and poverty, which may be major risk factors leading to the childhood unintentional injuries (Lao et al., 2012). However, it is likely that environmental characteristics also play a critical role in the etiology of childhood injuries. Families in ‘‘problem’’ environments, for example those residing in disordered neighborhoods, may have greater exposures to other risk factors related to injury outcomes due to accidents, assaults, or child abuse among children and youth (Freisthler et al., 2008).

2.12 Childhood Injury Economic Impact

Approximately 2000 families were affected by children unintentional injuries per day (World Health Organization, 2008). Unintentional injury can lead to irreversible consequences for most children and untreated accidental injury is associated with numerous adverse outcomes, including death, disability and increasing demand for hospital care. The economic cost of UI is enormous, and it imposes a large economic burden on societies, ranging from US $0.5 million to US $9.5 million per year (Lao et al., 2012). Injuries account for approximately 15 percent of medical spending for children and youth ages 1 to 19, making these injuries a costly childhood problem(Miller, Romano, & Spicer, 2000). These statistics give testimony to the importance of research that explores the causes and consequences of childhood injuries (Freisthler et al., 2008)

The direct and indirect economic costs of childhood unintentional injuries were mainly calculated by Lao et al., by using medical treatment related length of stay (LOS) and loss of healthy years. As these factors represent a huge economic expenditure of the studied countries, particularly low-and-high income countries. The study identified a large difference in childhood unintentional injuries between the genders, different age groups of children, low-and-middle income countries and high-income countries (Lao et al., 2012). However, the lack of global data on the cost of unintentional child injuries means there is a great need for the analysis of unintentional injuries costs among children (Doll et al., 2007).

2.13 Cost Associated with Childhood Injuries

Children's Safety Network analysis of injury cost reflects the overall economic burden it has on U.S. The burden of injuries in children and adolescents ages 0 to 19 in the U.S. is reflected in the costs of fatalities, hospitalizations, and emergency department (ED) visits. In 2015, childhood injuries contributed to:

- $111.6 billion in fatalities
- $119.9 billion in hospitalizations
- $305.5 billion in ED visits

Motor vehicle traffic, homicide/assault, suicide/self-harm, drowning, poisoning, fire/burn, falls, and struck by/against and are the leading causes of injuries in children and adolescents. Together, these injuries represent 61% of all injury-related fatality costs ($68.0 billion), 80% of all injury-related hospitalization costs ($96.3 billion), and 79% of all injury-related ED visit costs ($240.2 billion). These estimates are based on injury data from the Centers for Disease Control and Prevention (CDC) and unit costs from the Pacific Institute for

Research and Evaluation's (PIRE) widely cited injury cost model. Injury costs include medical costs, work loss costs, and quality of life loss costs. (CSN, 2017).

- Medical costs include emergency medical services, physician, hospital rehabilitation, prescription, and related treatment costs, including ancillary costs for crutches, physical therapy, and coroner/medical examiner expenses in the case of fatalities.
- Work loss costs include victims' lost wages and the value of lost household work. In the case of fatalities, work loss costs include the value of earnings and household work over the victim's expected remaining lifespan in the absence of premature death.
- Quality of life loss costs are the monetary value of pain, suffering, disfigurement, and lost capacity to function physically, including lost sensory, mobility, and cognitive functioning, as well as ability to work and to perform activities of daily living. This measure excludes work losses to avoid double counting.

2.14 Short-Term & Long-Term Effects of Childhood Unintentional Injuries

The leading causes of injury differ for children and adolescents (FIFCFS, 2017). The devastation UI has on the child and families can present both short and long-term effects. Physical injuries can vary from minor to transitory to devastating. Children may also experience the emotional effects of hospitalization, altered growth and development, lost time in school, and time away from family members and peers. Furthermore, the child is not the only member of the family who suffers. Parents who care for an injured child often have difficulty

maintaining work schedules, which can eventually affect the family's finances (Crawley-Coha, 2001).

Although financial problems may be short-lived, there is some evidence that a large number of families had problems that persisted 6 months after hospital discharge, even those whose child was hospitalized for only 1 day. Not surprisingly, families have an even greater chance of developing problems with work and finances if their child has a long acute hospital stay or was left with four or more impairments at the time of discharge (Osberg, Kahn, Rowe, & Brooke, 1996).

2.15 Role of the Emergency Department in Childhood Injuries

The emergency department (ED) plays an important role in the first line of connective care for childhood injuries. Visits through the ED often represents the initial contact with a provider for an injury sustained by a pediatric patient (Burt, McCaig, & Rechtsteiner, 2007). More specifically the use of ED data has been used to analyze pediatric mortality and morbidity by cost and trauma types. Tracking patterns through the ED can is critical to obtain vital data to effect change in the prevention and treatment of childhood UI. Understanding patterns of injury for pediatric patients can provide healthcare practitioners with valuable information about the frequency and trauma types of injuries that are seen in the ED and can allow for resources to be directed toward preparing for and preventing those injuries (Ferguson et al., 2013).

Once the differences in trauma type, patterns and cost are understood, appropriate data can be gathered, and effective preventive measures can be instituted. Public officials and healthcare practitioners recognize that injuries are surmountable to the diseases that once killed children, they are predictable, preventable and controllable. The U.S. Centers for Disease

Control and Prevention (CDC) works closely with other federal and state agencies, national, state and local organizations and research institutions to reduce deaths and nonfatal injuries, disabilities and costs of childhood injuries in the United States (Borse & Sleet, 2009). The CDC and WHO reports and research on childhood injury can inform the work of practitioners, policymakers, elected officials, and researchers to better understand the problem and take the necessary steps to reduce the devastating burden childhood injuries place on the nation (Ferguson, Shields, Cookson, & Gielen, 2013).

Research has been established that injury varies according to age groups. This is also confirmed by injury data obtained from visits through the ED recorded in hospital injury surveillance system. According to Federal Interagency Forum on Child and Family Statistics (FIFCFS); America's children key national indicators of well-being, the leading causes of injury visits through the ED differ for children and adolescents. ED data corroborates that injury accounts for about 75 percent of adolescent deaths. Compared with younger children ages 1-14, adolescents ages 15–19 have much higher death rates overall and injuries. Adolescents are much more likely to die from injuries sustained from motor vehicle traffic crashes and firearms than are younger children (FIFCFS, 2017; Sleet et al., 2010). In 2012–2013, the top five causes of injury-related emergency department (ED) visits among adolescents were being struck by or against an object or person, falls, motor vehicle traffic crashes, overexertion, and being cut or pierced (Sleet, 2018) .

2.15a Leading Causes of Injuries Related ED Visit 1-14

- Falls and being struck by or against an object or person are the two leading causes of injury-related emergency department (ED) visits, Falls accounted for more than one-third of injury-related ED visits for children ages 1–4 and more than one-quarter of

initial injury-related ED visits for children ages 5–14. Among children ages 1–4, injuries from being struck accounted for 13 percent of all injury ED visits in 2012–2013 and 20 percent of initial injury ED visits among children ages 5–14.

- Injury-related ED visits for injuries caused by natural and environmental factors, including insect and animal bites, were 9 visits per 1,000 for children ages 1–4 and 7 visits per 1,000 for children ages 5–14.
- Injury-related ED visits resulting from being cut or pierced, the fourth leading cause of injury visits, were 6 per 1,000 for children in each age group.
- Injury-related ED visits for injuries caused by motor vehicle traffic crashes were the fifth leading cause of injury visits among children ages 1–14, at 4 visits per 1,000 for children ages 1–4 and 5 visits per 1,000 for children ages 5–14.
- Motor vehicle traffic (MVT) was the leading mechanism of injury deaths among adolescents ages 15–19 in 2015. The MVT death rate for adolescents declined from 42 deaths per 100,000 adolescents in 1980 to 12 deaths per 100,000 in 2015. (FIFCFS, 2017)

2.15b Leading Cause of Injuries related ED Visit: Age 15-19

- Injury-related ED visits among adolescents ages 15–19 from being struck by or against an object or person (23 visits per 1,000), falls (22 visits per 1,000), and motor vehicle traffic crashes (18 visits per 1,000), accounted for about one-half of the injury-related ED visits for this age group in 2012–2013.
- Injuries caused by overexertion from excessive physical exercise or strenuous movements in recreational or other activities resulted in approximately 10 visits per 1,000 adolescents ages 15–19 in 2012–2013.

- Injuries resulting from cutting or piercing from instruments or objects accounted for 6 visits per 1,000 adolescents ages 15–19 in 2012–2013. The majority of these injuries were unintentional.
- The ED visit rate for injuries due to natural or environmental factors was 6 visits per 1,000 adolescents ages 15–19 in 2012–2013 (FIFCFS, 2017).

Unintentional injury and deaths medical contact originates in the emergency room for initial care and treatment. From 1999 through 2017, the age-adjusted unintentional injury death rate increased 40% from 35.3 deaths per 100,000 standard population to 49.4. Overall, unintentional injury death rates increased from 1999 through 2017, although trends varied by leading causes of the injury deaths (Albert & McCaig, 2014). The ED is the primary provider of stabilizing for acute trauma and initial medical treatment of these injuries and unfortunate deaths. Leading causes of injury-related ED visits among both males and females aged 18 years and under included falls and striking against or being struck unintentionally by objects or persons. Young children are particularly vulnerable as they depend on others for safety in their environment (Simpson, Turnbull, Ardagh, & Richardson, 2009).

2.16 Medical Costs of Childhood Injuries: Emergency Department Visits

In 2009–2010, an annual average of 11.9 million injury-related emergency department (ED) visits were made by children and adolescents aged 18 years and under in the United States (Albert & McCaig, 2014). In 2015, the total medical costs of injury-related ED visits of children age 19 and younger was $18.3 billion These costs include the initial ED visit, expenses for emergency transport, follow-up visits (ED, outpatient, or physician), medication, and insurance and claims administration expenses. Injuries shown in Table 5 represents total medical costs of

injury-related ED visits. In this table Unintentional injuries represent over $11 billion in total medical costs of injury-related ED visits (CSN, 2017).

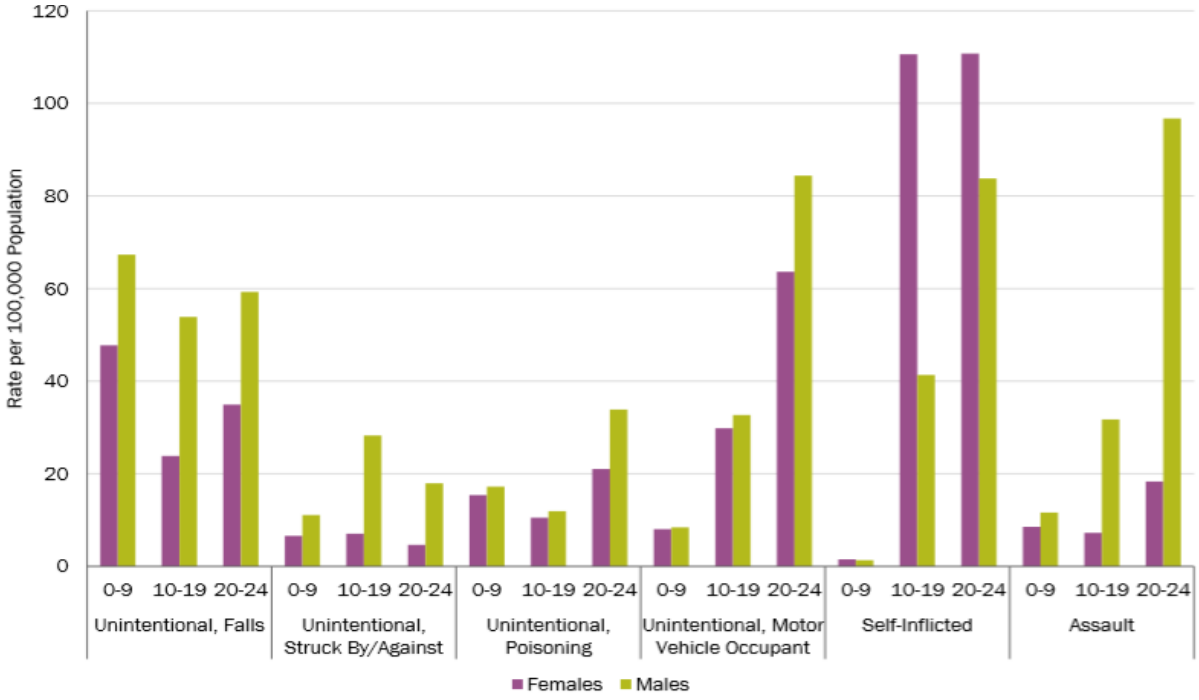
Table 5. Total medical costs of injury-related ED visits

	Cost
Falls* (ages 0-19)	$6.3 billion
Struck By/Against*[1] (ages 0-19)	$3.9 billion
Assault (ages 0-19)	$677.0 million
Teen Occupant*[2] (ages 15-19)	$597.3 million
Child Occupant* (ages 0-14)	$364.6 million
Poisoning* (ages 0-19)	$226.2 million
Fire/Burn* (ages 0-19)	$210.4 million
Self-Harm (ages 10-19)	$101.9 million
Drowning* (ages 0-19)	$9.1 million

Source: CDC, WISQARS,2015: www.cdc.gov/ncipc/wisqars

Cases seen in the ED often require hospitalization. HCUP data in Figure 5 shows the hospitalization rates by categories for males and females. Unintentional injury categories are higher for males in all categories except for self-inflicted injuries. Table 6 shows the cost of hospitalization by age group and gender. This confirms that males generate higher cost at a higher rate for unintentional injuries (CSN, 2017).

Figure 5: Rates of Injury Hospitalizations Per 100,000 Population, Ages 0-24 By Sex, 2013



Source: Healthcare Cost Utilization Project (HCUP) Nationwide Inpatient Sample (2013).

Table 6. Rate Per 100,000 Population and Cost of Injury Hospitalization by Sex, Ages 0-24, 2013

		Females		Males	
Leading Cause	Age Group	Rate	Total Cost (in billion)	Rate	Total Cost (in billion)
Unintentional, Falls	0-9	47.8	$8.00	67.4	$13.18
	10-19	23.9	$3.39	53.9	$9.61
	20-24	34.9	$2.30	59.3	$6.02
Unintentional, Struck By/Against	0-9	6.6	$1.17	11.1	$1.96
	10-19	7.0	$0.91	28.3	$4.50
	20-24	4.7	$0.29	18.0	$1.51
Unintentional, Poisoning	0-9	15.4	$0.05	17.2	$0.05
	10-19	10.5	$0.03	12.0	$0.05
	20-24	21.0	$0.05	33.9	$0.08
Unintentional, Motor Vehicle Occupant	0-9	8.1	$1.49	8.5	$1.73
	10-19	29.9	$5.22	32.7	$6.92
	20-24	63.6	$5.16	84.4	$9.22
Self-Inflicted	0-9	1.5	$0.06	1.4	$0.11
	10-19	110.6	$1.74	41.3	$1.45
	20-24	110.8	$0.96	83.8	$1.72
Assault	0-9	8.6	$2.51	11.6	$3.78
	10-19	7.2	$0.89	31.7	$5.01
	20-24	18.3	$1.28	96.7	$8.33

Note: Cost of hospitalization in 2013 Dollars.
Source: HCUP Nationwide Inpatient Sample (2013).

Data collected through the ED is done through an injury surveillance system. The data collected has the potential to impact important parts of program planning for prevention, clinical management and the allocation of resources for interventions. An ideal injury surveillance system for pediatric patients should be designed with at least 3 main elements: minimal economic and resource burden, substantial practical uses for health practitioners, and measures to ensure data quality and minimized bias (Ferguson et al., 2013).

2.17 Injury Surveillance System

Injury surveillance is defined as: "the ongoing systematic collection, analysis, and interpretation of injury data, for use in planning, implementation and evaluation of prevention activities". Injury prevention programs use surveillance data to assess the need for new policies or programs and to evaluate the effectiveness of those that already exist (Concha-Eastman & Villaveces, 2001). The injury events that will be included in a surveillance system determine which data sources are necessary to provide information to the surveillance system. The availability and quality of data are important criteria when selecting data sources (MMWR, Morbidity and Mortality Weekly Report, 2001). Surveillance systems data are only as accurate as data imputed by the health practitioners. Practitioners should be sensitive to the possible stigmatization of groups as a result of categorization in surveillance data (Teutsch & Churchill, 2000). Data limitation may exclude accountability of practitioner's bias or omissions in certain data fields.

Borse and Sleet research studies used injury death data from the National Center for Health Statistics, National Vital Statistics System (i.e. death certificate data), and nonfatal injury information from the National Electronic Injury Surveillance System (Borse & Sleet, 2009). There were some limitations in their review using this method. The Health Policy and Research

center at University of California at Irvine conducted a study titled “Sensitivity of Hospitals' E-Coded Data in Identifying Causes of Children's Violence-Related Injuries” used ICD-9 CM E-coded discharge data from hospitals provide an opportunity to use this source of morbidity data for planning, implementation and evaluation of injury and violence prevention activities. This study explored the extent to which E-coded data from hospitals identify injuries that result from violent acts. Cases were identified through a multihospital population-based surveillance system of pediatric injuries (Winn et al., 1995). Most of the reviewed research articles used ICD-9 codes to define different types of unintentional injuries which transitioned to the current defined by ICD-10 codes (Lao et al., 2012).

2.18 Preference for using ICD-10 E-coded Data

The ICD-10 is a diagnostic and procedural coding system implemented by the World Health Organization in 1993 as a replacement for the ICD-9, released in the 1970s. The purpose of the ICD-10 is to support the worldwide systematic recording, analysis, interpretation, and comparison of morbidity and mortality data(WHO & ISCDRHP, 2011). The need to transition from the ICD-9 to the ICD-10 is cited for several reasons, including elimination of outdated ICD-9 terminology, insufficient specificity, and rapidly declining code space resulting from numerous new diagnosis codes annually submitted for review and approval (Harrington, 2014). ICD-10-CM is maintained by the National Center for Health Statistics (NCHS (Pickett, Berglund, Blum, & Wing, 1999). The ICD-10 is copyrighted by the WHO, which owns and publishes the classification (CDC & NCHS, 2019).

External cause–of–injury codes (E-codes) are the ICD codes used to classify injury incidents by mechanism (e.g., motor vehicle, fall, struck by/against, firearm, or poisoning) and intent (e.g., unintentional, homicide/assault, suicide/self–harm, or undetermined). Sometimes

the external cause is referred to as the “mechanism of injury” and the intent is referred to as the “manner of death”(CDC & NCHS, 2019). ICD-10 E-coded data can serve as an excellent source of raw information about injuries in a given hospital and can provide clinicians and injury researchers with a wealth of ideas for improved clinical approaches, program development, and possible prevention intervention strategies (Ferguson et al., 2013). Ferguson et al., conducted a literature review for E-coding Pediatric Emergency Department (PED) as well as for injury surveillance more generally in the PED using the databases; PubMed, PubMed Central, Google Scholar, CINAHL, EMBASE, and Academic Search Elite. Inclusion criteria were applied for each search engine conveying injury surveillance in the pediatric emergency department has the potential to be an important part of program planning and clinical management (Ferguson et al., 2013).

Such research studies have contributed substantial progress to lowering the number of children injured or killed by preventable or unintentional injuries. Over the past 11 years, the death rate due to preventable injuries has declined by 35%. This progress has been made in large part because of the efforts of nurses, physicians, law enforcement agents, judges, and others who have joined together to address the issue of preventable injuries (Safe Kids Worldwide, 2001; Safe Kids Worldwide, 2015; World Health Organization, 2008). Although a great deal has been accomplished, much work still remains. More than 39,000 children per day or 14 million children per year require medical attention for an unintentional injury. Every year 120,000 children are permanently disabled by preventable injuries (Crawley-Coha, 2001). The limited number of studies that were identified by Ferguson et al., review underscored the need for additional research on demonstrating the feasibility, quality, and utility of individual hospital pediatric emergency department (PED) injury surveillance systems (Ferguson et al., 2013).

Based on the review of the past and current literature on cost and childhood unintentional injury, the public health system would benefit from future research using ICD-10 E-codes to analyze data at the state level to better inform and impact the implementation of interventions, policies and prevention programs for specific or targeted area.

2.19 South Carolina State Childhood Injury Facts

The state of South Carolina looks at child injuries primary through the lens of abuse and neglect, fatalities, violence and maltreatment of children to better focus on the prevention and overall child well-being. Multiple organizations collaborate on community coalitions to address issues that contributes to child mortality and morbidity. Limited literature was found specifically related to unintentional injury for children age 0-19 beyond national and state data reports. The most comprehensive literature review of data for South Carolina was found in the Children's Safety Network (CSN) National Injury and Violence Prevention Resource Center Report and the State Child Fatality Advisory Committee (SCFAC) report.

2.20 Children's Safety Network Report Review

According to the CSN National Injury and Violence Prevention Resource Center Report, unintentional injuries and violence are the leading causes of death, hospitalization, and disability for children ages 1-18. CSN provides information and technical assistance on injury surveillance and data; needs assessments; best practices; and the design, implementation, and evaluation of programs to prevent child and adolescent injuries (CSN, & EDARC,2016; CSN, 2015). For data validity and to provide thorough analysis CSN uses multiple data sources which includes:

- **Multiple Cause of Death (MCOD), National Center for Health Statistics:** The MCOD file is a census of all deaths in the U.S. and some territories.
- **State Inpatient Databases (SID):** The SID is a census of hospital discharge data compiled from, currently, 46 states. Counts exclude patient dead at the time of discharge, chronic/overuse injuries, and/or injuries treated at hospitals that do not meet the American Hospital Association's (AHA) criteria of a short-term community hospital. All counts based on the patients' state of residence.
- **Healthcare Utilization Project, Agency for Healthcare Research and Quality (AHRQ):**The AHRQ sponsors a Federal-State-Industry partnership, known as HCUP, which includes the largest collection of health care databases and associated software and products in the country, including the SID, from collaborating states.
- **Fatal Analysis Reporting System (FARS), National Highway Traffic Safety Administration**: The FARS is a census of all motor vehicle-related crashes involving one or more fatalities. FARS provides data on all vehicles involved in fatal crashes, including driver information.
- **Population Statistics**: The report uses statistics from the United States Department of Health and Human Services (US DHHS), Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS), Bridged-Race Population Estimates, United States resident population by state. Retrieved from: http://wonder.cdc.gov/bridged-race-v2013.html.

CSN data for a 5-year range 2008-2012 reported unintentional injury as the leading cause of death for age groups 0-19 in South Carolina shown in Table 7a.

Table 7a. Leading Causes and Total 5-Year Incidence of Deaths by Age Group, South Carolina 2008-2012

	Age Groups						
Rank	**<1**	**1 - 4**	**5 - 9**	**10 - 14**		**15-19**	**20-24**
1	Congenital Anomalies 378	Unintentional Injury 123	Unintentional Injury 72	Unintentional Injury 91		Unintentional Injury 549	Unintentional Injury 807
2	Short Gestation 326	Congenital Anomalies 40	Malignant Neoplasms 27	Malignant Neoplasms 35		Suicide 135	Homicide 290
3	SIDS 229	Malignant Neoplasms 38	Congenital Anomalies 15	Suicide 22		Homicide 132	Suicide 240
4	Unintentional Injury 173	Homicide 36	Homicide 13	Heart Disease 13	Homicide 13	Heart Disease 39	Malignant Neoplasms 65
5	Maternal Pregnancy Comp. 152	Heart Disease 12	Heart Disease 12	Chronic Low. Respiratory Disease 10		Malignant Neoplasms 32	Heart Disease 62

Source: Children's Safety Network, 2015

CSN review of unintentional injury by mechanism for South Carolina leading causes and total incidence of injury deaths is shown in Table 7b for 2009-2013. This data continues to be consistent with CDC and WHO published data recording MVT, Drowning, Fire/Burns, Poisoning, and Suffocation (0-1) as the leading causes of death among children age 0-19 (CSN & EDARC, 2016).

Table 7b. Leading Causes and Total 5-Year Incidence of Injury Deaths by age Group, South Carolina, 2009-2013

Age Groups												
Rank	<1		1 - 4		5 - 9	10 - 14		15-19	20-24
1	Suffocation 134		Drowning 38	Homicide 38	MVT 37	MVT 41		MVT 345	MVT 521
2	Homicide 32		MVT 31		Homicide 16	Suicide 24		Suicide 131	Homicide 290
3	Undetermined Suffocation 22		Fire/Burn 20		Drowning ****	Drowning 14		Homicide 122	Suicide 241
4	MVT 10		Suffocation 12		Fire/Burn ****	Homicide 12		Poisoning 43	Poisoning 171
5	Unspecified ****	Undetermined Unspecified ****	Firearm ****		*Four Tied ****	Firearm ****	Other land transport ****	Drowning 40	Drowning 32

Note: All mechanisms of suicide and homicide were combined according to intent. Each listed mechanism is unintentional except those otherwise noted. **** = indicates that the cell values range from 1-9 and are suppressed for data confidentiality purposes. *For age <1, four mechanisms were tied for the third ranking including MVT, Other transport, Poisoning, and Other specific and classifiable. **For age 1-4, three mechanisms were tied for the fourth ranking including Drowning, Pedestrian, other, and Other transport. ^For age 5-9, three mechanisms were tied for the fourth ranking including Other transport, Homicide, and Undetermined Suffocation. Each of these mechanisms had fewer than 10 deaths.

Data Source: South Carolina Multiple Cause of Death File (MCOD), 2009-2013, National Center for Health Statistics..

2.21 State Child Fatality Advisory Committee Report Review

South Carolina is invested in addressing issues related to the well-being of children and ways to better understand the determinants of child fatalities and injuries through a state mandate. The State Child Fatality Advisory Committee (SCFAC) is mandated by S.C. Code 20-7-5920 to identify patterns in child fatalities that will guide efforts by agencies, communities and individuals to decrease the number of preventable child deaths. As defined by S.C. Code 207-5900 a "child" means a person less than eighteen years of age. SCFAC investigates all child death under the age of 18 years when the death is unexpected and unexplained including, but not limited to, possible sudden infant death syndrome (SIDS), as a result of violence, when unattended by a physician and in any unusual or suspicious manner (SCFAC, 2019). S.C. Code 63-11-1950 mandates that the State Child Fatality Advisory Committee (SCFAC) review

completed investigations of deaths involving children age 17 years and younger that are unexpected, unexplained, suspicious or criminal in nature for public reporting.

Since the mandate and the initiation of report starting with the 2006 data year, SCFAC has been assigned 2,674 cases. Of those, 2,248 (84.1%) have been completed, leaving a balance of 426 cases to be completed. The SCFAC currently has a caseload balance of 189 cases from 2006-2017 with a year of occurrence breakdown as follows: 2006-2009 (0 cases), 2010 (1 case), 2011-2013 (0 cases), 2014 (6 cases), 2015 (2 cases), 2016 (49 cases) and 2017 (189 cases) remaining to be reviewed and completed shown in Table 8 (SCFAC, 2019).

Table 8. Death Cases By Year Assigned, Cases Completed and Case Balance

Year Case Assigned to SLED	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018*	Total
Total Cases Assigned	218	266	233	205	187	170	137	132	351	185	195	216	179	2674
Cases Completed	218	266	233	205	186	170	137	132	345	183	146	27	0	2248
Caseload Balance	0	0	0	0	1	0	0	0	6	2	49	189	179	426
Percent of Cases Completed (%)	100	100	100	100	99.5	100	100	100	98.3	98.9	74.9	12.5	0.0	84.1

*Partial Year

Source: SCFAC, 2019

This table is not a summary of all child deaths occurring during the time period of 2006-2016. The Committee does not review motor vehicle crashes except as related to injuries on private property or as a pedestrian. The South Carolina Department of Public Safety (SCDPS) investigates all motor vehicle deaths. With the assistance of the State Law Enforcement Division (SLED) Department of Child Fatalities, the Committee does a comprehensive review of all cases under investigation.

SCFAC review cases according to manner of death determination and place each fatality into one of five main categories: natural, unintentional injury, homicide, suicide, and undetermined (CSN, 2015). Of the reportable deaths the two largest categories of South Carolina child fatalities continue to be natural and unintentional injury. Together, they account for 72.6% of child fatalities, with natural deaths representing 42.4% and unintentional injury representing 30.2%. These categories were followed by homicide (11.2%), undetermined (8.3%) and suicide (4.9%) Within the category of natural deaths, SIDS represents 37.9% of natural deaths for unintentional suffocation deaths for children age 0-1 (CSN & EDARC, 2016; et, al., Nichols, 2002)

2.21a Suffocation/Sudden Infant Death Syndrome (SIDS)

The most common cause and manner of death in infants/children (0-1) year is suffocation from unsafe sleep-related injury. The SCFAC continues to identify unsafe sleep as being a major causal factor in child deaths with 96 deaths or 40% of the total deaths reviewed during SFY2018 attributable to unsafe sleeping conditions. The issue of unsafe sleeping conditions was a factor among 84% (96 out of 114) of deaths in children under the age of 12 months (SCFAC, 2019). There was no other instance in which a single cause represented such a large proportion of the unintentional injury deaths. At 1 year of age, this proportion dropped to 16.8%, and by 12 years and older, less than 5% of unintentional injury deaths were caused by suffocation (Dellinger & Gilchrist, 2019). South Carolina has implemented injury-related State Performance Measure to reduce the percent of combined infant deaths due to SIDS as a result of unsafe sleeping environments. The state set an injury priority to reduce the number of infant deaths due

to SIDS/positional asphyxiation (CSN, 2015). The SC General Assembly has made unsafe sleep a legislative priority by allocating fiscal resources to support:

- Media campaign designed to reinforce a common, clear and unified message around safe sleep
- Prevention strategies designed to reach parents, grandparents, family members, caregivers, and healthcare professionals with current evidence-based information on safe sleeping practices.
- Collaboration with the South Carolina Birth Outcomes Initiative (BOI) to eliminate sleep-related deaths by providing prevention education and consistent message and support to healthcare providers, parents, caregivers and the community.
- The establishment of a legislative mandate to require blood testing for alcohol and drugs of caregivers involving the suspicious, unexplained or unexpected sleep related death of a child under the age of 1 year (SCFAC, 2019) .

2.21b Homicide and Suicide

In South Carolina homicide and suicide ranks second highest for children ages 5-19, homicide is tied with drowning for age 1-4 (CSN & EDARC, 2016). South Carolina Department of Mental Health reported Suicide as the leading cause of death for ages 10-14 and 2nd leading cause of death for ages 15-17 (SCMDH, 2017). Suicide is the 4th leading cause of death and the 3rd leading cause of injury-related death among US youth 10-24 years of age (CDC & YRBSS, 2017). Youth Risk Behavior Surveillance Survey (YRBSS) provides information about behaviors that contribute to unintentional and

intentional violence among youth. According to the 2011 YRBSS, 15.8% of students seriously considered attempting suicide and 7.8% of students attempted suicide one or more times in the 12 months prior to the survey by various means. In South Carolina 53% of youth aged 15 through 19 completed suicide by using a firearm, 38% by suffocation and 9% by other means and more common in males than in females (SCFAC, 2019).

Although progress has been made over the past decade in reducing the rate of completed suicides nationally, this reduction has leveled off in the last few years (CDC & YRBSS, 2017; Sleet et al., 2010). The DMH received a youth suicide prevention grant of $736,000 per year for five years from the Substance Abuse and Mental Health Services Administration (SAMHSA) to fund Suicide Prevention Initiatives. DMH Youth Suicide Prevention Initiative developed a South Carolina Schools Suicide Prevention Program for school to implement in conjunction with increased funding for statewide school-based mental services. The program is an intensive community-based effort with a goal of reducing suicide among youths and young adults, aged 10 to 24, by 20% statewide by 2025 (SCMDH, 2015). Currently more than 45 South Carolina schools have implemented or are at various stages in the process of implementing the program (SCFAC, 2019).

2.21c Poisoning Risk Factor Rises

Poisoning is a rising contributing factor in injury and death of children. Poisoning can be intentional or unintentional. In 2015, 782 children and adolescents aged 0-19 died of unintentional poisoning, and there were an additional 12,309 hospitalizations and 105,632 ED visits related to unintentional poisoning in the US

(CSN, 2017). Poisoning cases reported for South Carolina include prescription medications (Rx), illicit drugs and other, unspecified drugs. The Opioid crisis is having a resounding impact on increased poisoning rates for youths and adolescents. Drug overdose death rates among all ages in the US have more than tripled since 1990 and have never been higher (Yeargin, 2019). The percentage distribution of fatal unintentional and undetermined drug poisoning by drug type for the period 2008-2012 youths aged 15 through 19 in South Carolina were 49% Rx drugs only, 33% Other/ Unspecified, 11% illicit only drugs, and 7%, Rx and illicit drugs (CSN & EDARC, 2016).

In 2012, nearly 6,000 children aged 0 through 4 were hospitalized and another 55,000 were treated and released from U.S. emergency rooms for medication poisoning (HCUP, 2012).These poisonings resulted in $154 million in medical spending and $14 million in parent work losses (CSN, EDARC, 2015). Nearly all emergency department visits to young children (95 percent) are a result of unsupervised children getting into medication; only five percent of these visits were due to errors on the part of the caregiver (Pediatrics, 2011). South Carolina Palmetto Poison Center offers several free poison prevention education programs in partnership with Safe Kids, Department of Social Services, Crescent Health, Faith-based Organizations, and South Carolina Education School-based programs.

2.21d Drowning-Related Deaths/Injuries

Monthly, approximately one (1) resident of South Carolina age 17 years of age and younger dies (total of19 deaths in 2017) from a preventable drowning with the death rate of 1.7, higher than the rate for all ages of 1.4 per 100,000 population. In drowning

deaths reviewed by the advisory committee, the location of drownings varies widely by age group. Drowning is tied with homicide for age group 1-4 as the leading cause of death and is the 3rd. for ages 5-14. South Carolina geography consist of multiple water access including lakes, ponds, rivers and beaches which makes children in the age group more susceptible to this injury and cause of death. Yet, children age 1-4 also drown in bathtubs, pools, hot tubs or spas (SCFAC, 2019) .

The state requires local schools, community agencies and/or local recreational safety commissions to take the leadership in assuring that every community has a water safety program available to every child. State prevention recommendations emphasize adult supervision of children around any body of water and require warning signs around lakes, ponds and river areas that are popular attractions for swimming/boating activities. The state also stresses responsible safety measures for private pool owners, especially in regard to adequate fencing/barriers around pools (CSN & EDARC, 2016; et. al., Nichols, 2002).

2.21e Motor Vehicle Transportation

South Carolina residents die daily from a preventable transportation-related incident. In 2017 there were 1097 deaths from transportation accidents: motor vehicle fatalities (1056), other land transportation fatalities (20) or other types, to include water, air, etc. (21). About 5% of these incidents involve children age 17 years and younger. Weekly, approximately 1 South Carolina child age 17 years and younger (55 incidents in 2017) dies from a preventable transportation-related incident (SCFAC, 2019). Motor vehicle-related deaths remain a major cause of death for children 5-19 in South Carolina. Many of these motor vehicle related deaths can be prevented through the

implementation of a broad range of evidence-informed interventions and programs which the state has untaken (CSN & EDARC, 2016). SC General Assembly has made the issue of motor vehicle injuries involving children a legislative priority by allocating fiscal resources to support:(SCFAC, 2019)

- Coordinated media campaign designed to help raise public consciousness of best practices and various transportation safety-related laws.
- Expanding primary prevention strategies designed to reach teenagers, parents and caregivers, such as School Transportation Safety Observations to improve safety and child safety restraint utilization and Alive at 25 to educate youth about the dangers of driving.
- Adoption of the CDC recommendations found in the Prevention Status Report (PSR) related to best practices for a child passenger restraint law, graduated drivers licensing, learner's permit age, learner's permit holding period, young passenger restrictions, unrestricted licensure age, and ignition interlock system.

2.22 South Carolina Injuries Across Disparities

Literature Review has been established the nature and extent of unintentional injury varies widely by race, age, geographic, cultural, urban/rural, and other risk factors (Ballesteros et al., 2018; Sleet, 2018). CSN state data on the injury-related Maternal and Child Health Block Grant National Performance Measures and Health Status Indicators was a special focus on disparities based on race, gender, and rural/urban residence. The research was funded by the Maternal and Child Health (MCH) Bureau which works with states to utilize a science-based, public health approach for injury and violence prevention (IVP). In particular, disparities in the risk of intentional and unintentional child and adolescent injuries are found across several

distinct populations within sex, race/ethnicity, geography, disability, sexual orientation and gender identity, health literacy, and socioeconomic status (SES), among others.

CSN report found that one way to better understand disparities is to look at the rate of injuries by place of occurrence. To show this, CSN provided the rates for the 0–14, 15-19 and 20-24 age groups using the urban rural classification system developed by the National Center for Health Statistics (NCHS) defined in Table 9, NCHS data systems are often used to study the association between urbanization level of residence and health and to monitor the health of urban and rural residents. Conducting such analyses requires an urban-rural classification scheme. This information allows the state to better understand any disparity that may occur between the different settings for injured children. NCHS examine data with this method to provide a broad overview of the magnitude of the problem in targeted areas and highlights possible disparities which may exist by race, gender, and rural/urban areas as contributing factors for injury risk (Ingram & Franco, 2006).

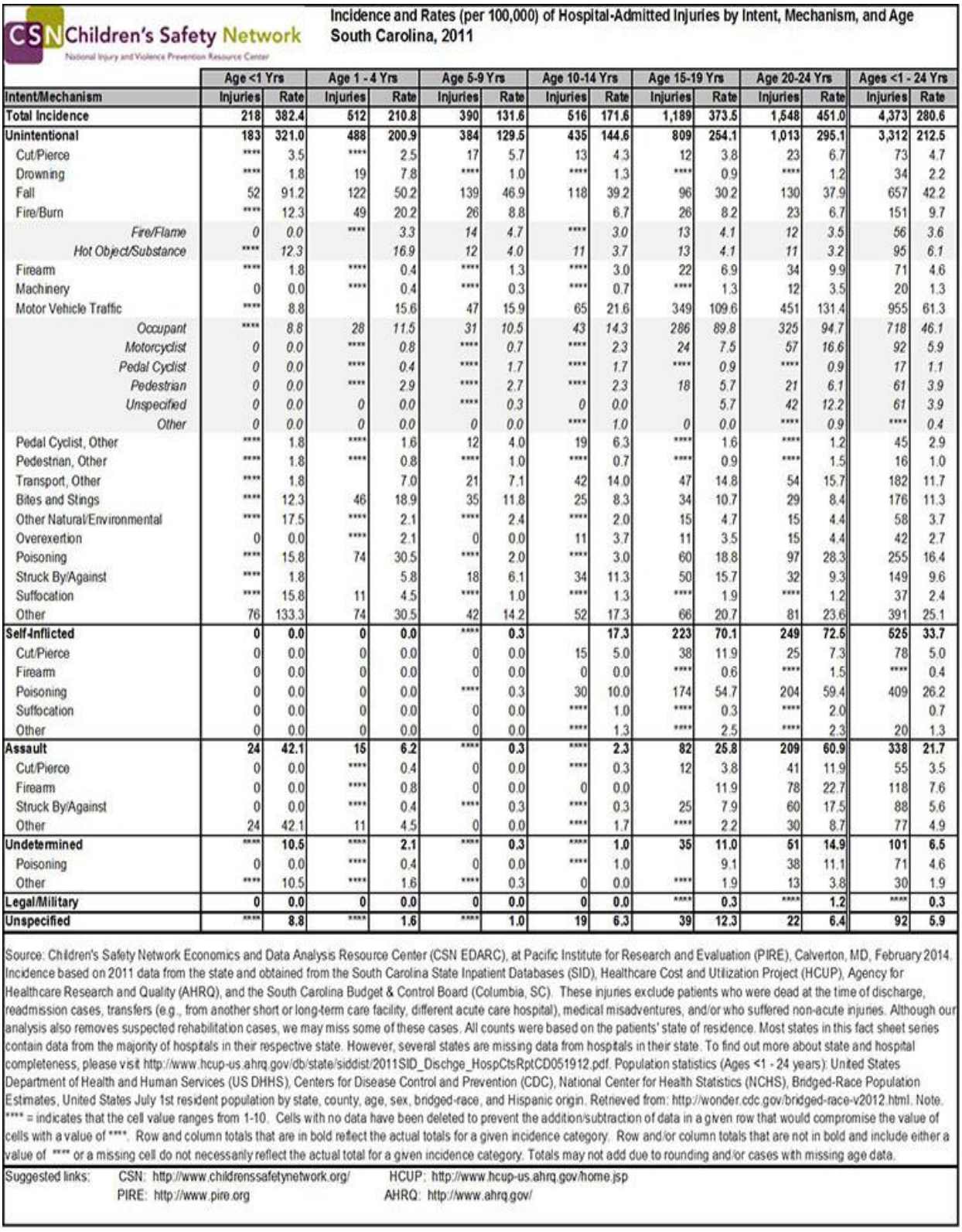
Table 9. Classification rules used to assign counties to the six urbanization levels of the 2006 NCHS Urban-Rural Classification

Urban-rural category	Classification rules
Metropolitan	
Large central metro[1]	Counties in a metropolitan statistical area of 1 million or more population: 1) that contain the entire population of the largest principal city of the metropolitan statistical area, or 2) whose entire population resides in the largest principal city of the metropolitan statistical area, or 3) that contain at least 250,000 of the population of any principal city in the metropolitan statistical area
Large fringe metro	Counties in a metropolitan statistical area of 1 million or more population that do not qualify as large central
Medium metro	Counties in a metropolitan statistical area of 250,000 to 999,999 population
Small metro	Counties in a metropolitan statistical area of 50,000 to 249,999 population
Nonmetropolitan	
Micropolitan	Counties in a micropolitan statistical area
Noncore	Counties that are neither metropolitan nor micropolitan

Source: National Center for Health Statistics, 2006

CSN data further show the significant and frequency of unintentional injury impact on South Carolina hospitals shown in the Incidence and Rates of Hospital-Admitted Injuries by Intent, Mechanism, and Age for 2011 in Figure 6. Unintentional injury is the leading causes of injury for age 0-19 and the highest incidence and rate of hospital admissions are consistent with the WHO and CDC public health data report (CSN & EDARC, 2016).

Figure 6: Children Safety Network Incidence and Rates report South Carolina 2011



Children's Safety Network
National Injury and Violence Prevention Resource Center

Incidence and Rates (per 100,000) of Hospital-Admitted Injuries by Intent, Mechanism, and Age
South Carolina, 2011

	Age <1 Yrs		Age 1 - 4 Yrs		Age 5-9 Yrs		Age 10-14 Yrs		Age 15-19 Yrs		Age 20-24 Yrs		Ages <1 - 24 Yrs	
Intent/Mechanism	**Injuries**	**Rate**	**Injuries**	**Rate**	**Injuries**	**Rate**	**Injuries**	**Rate**	**Injuries**	**Rate**	**Injuries**	**Rate**	**Injuries**	**Rate**
Total Incidence	**218**	**382.4**	**512**	**210.8**	**390**	**131.6**	**516**	**171.6**	**1,189**	**373.5**	**1,548**	**451.0**	**4,373**	**280.6**
Unintentional	**183**	**321.0**	**488**	**200.9**	**384**	**129.5**	**435**	**144.6**	**809**	**254.1**	**1,013**	**295.1**	**3,312**	**212.5**
Cut/Pierce	****	3.5	****	2.5	17	5.7	13	4.3	12	3.8	23	6.7	73	4.7
Drowning	****	1.8	19	7.8	****	1.0	****	1.3	****	0.9	****	1.2	34	2.2
Fall	52	91.2	122	50.2	139	46.9	118	39.2	96	30.2	130	37.9	657	42.2
Fire/Burn	****	12.3	49	20.2	26	8.8		6.7	26	8.2	23	6.7	151	9.7
Fire/Flame	*0*	*0.0*	****	*3.3*	*14*	*4.7*	****	*3.0*	*13*	*4.1*	*12*	*3.5*	*56*	*3.6*
Hot Object/Substance	****	*12.3*		*16.9*	*12*	*4.0*	*11*	*3.7*	*13*	*4.1*	*11*	*3.2*	*95*	*6.1*
Firearm	****	1.8	****	0.4	****	1.3	****	3.0	22	6.9	34	9.9	71	4.6
Machinery	0	0.0	****	0.4	****	0.3	****	0.7	****	1.3	12	3.5	20	1.3
Motor Vehicle Traffic	****	8.8		15.6	47	15.9	65	21.6	349	109.6	451	131.4	955	61.3
Occupant	****	*8.8*	*28*	*11.5*	*31*	*10.5*	*43*	*14.3*	*286*	*89.8*	*325*	*94.7*	*718*	*46.1*
Motorcyclist	*0*	*0.0*	****	*0.8*	****	*0.7*	****	*2.3*	*24*	*7.5*	*57*	*16.6*	*92*	*5.9*
Pedal Cyclist	*0*	*0.0*	****	*0.4*	****	*1.7*	****	*1.7*	****	*0.9*	****	*0.9*	*17*	*1.1*
Pedestrian	*0*	*0.0*	****	*2.9*	****	*2.7*	****	*2.3*	*18*	*5.7*	*21*	*6.1*	*61*	*3.9*
Unspecified	*0*	*0.0*	*0*	*0.0*	****	*0.3*	*0*	*0.0*		*5.7*	*42*	*12.2*	*61*	*3.9*
Other	*0*	*0.0*	*0*	*0.0*	*0*	*0.0*	****	*1.0*	*0*	*0.0*	****	*0.9*	****	*0.4*
Pedal Cyclist, Other	****	1.8	****	1.6	12	4.0	19	6.3	****	1.6	****	1.2	45	2.9
Pedestrian, Other	****	1.8	****	0.8	****	1.0	****	0.7	****	0.9	****	1.5	16	1.0
Transport, Other	****	1.8		7.0	21	7.1	42	14.0	47	14.8	54	15.7	182	11.7
Bites and Stings	****	12.3	46	18.9	35	11.8	25	8.3	34	10.7	29	8.4	176	11.3
Other Natural/Environmental	****	17.5	****	2.1	****	2.4	****	2.0	15	4.7	15	4.4	58	3.7
Overexertion	0	0.0	****	2.1	0	0.0	11	3.7	11	3.5	15	4.4	42	2.7
Poisoning	****	15.8	74	30.5	****	2.0	****	3.0	60	18.8	97	28.3	255	16.4
Struck By/Against	****	1.8		5.8	18	6.1	34	11.3	50	15.7	32	9.3	149	9.6
Suffocation	****	15.8	11	4.5	****	1.0	****	1.3	****	1.9	****	1.2	37	2.4
Other	76	133.3	74	30.5	42	14.2	52	17.3	66	20.7	81	23.6	391	25.1
Self-Inflicted	**0**	**0.0**	**0**	**0.0**	****	**0.3**		**17.3**	**223**	**70.1**	**249**	**72.5**	**525**	**33.7**
Cut/Pierce	0	0.0	0	0.0	0	0.0	15	5.0	38	11.9	25	7.3	78	5.0
Firearm	0	0.0	0	0.0	0	0.0	0	0.0	****	0.6	****	1.5	****	0.4
Poisoning	0	0.0	0	0.0	****	0.3	30	10.0	174	54.7	204	59.4	409	26.2
Suffocation	0	0.0	0	0.0	0	0.0	****	1.0	****	0.3	****	2.0		0.7
Other	0	0.0	0	0.0	0	0.0	****	1.3	****	2.5	****	2.3	20	1.3
Assault	**24**	**42.1**	**15**	**6.2**	****	**0.3**	****	**2.3**	**82**	**25.8**	**209**	**60.9**	**338**	**21.7**
Cut/Pierce	0	0.0	****	0.4	0	0.0	****	0.3	12	3.8	41	11.9	55	3.5
Firearm	0	0.0	****	0.8	0	0.0	0	0.0		11.9	78	22.7	118	7.6
Struck By/Against	0	0.0	****	0.4	****	0.3	****	0.3	25	7.9	60	17.5	88	5.6
Other	24	42.1	11	4.5	0	0.0	****	1.7	****	2.2	30	8.7	77	4.9
Undetermined	****	**10.5**	****	**2.1**	****	**0.3**	****	**1.0**	**35**	**11.0**	**51**	**14.9**	**101**	**6.5**
Poisoning	0	0.0	****	0.4	0	0.0	****	1.0		9.1	38	11.1	71	4.6
Other	****	10.5	****	1.6	****	0.3	0	0.0	****	1.9	13	3.8	30	1.9
Legal/Military	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	****	**0.3**	****	**1.2**	****	**0.3**
Unspecified	****	**8.8**	****	**1.6**	****	**1.0**	**19**	**6.3**	**39**	**12.3**	**22**	**6.4**	**92**	**5.9**

Source: Children's Safety Network Economics and Data Analysis Resource Center (CSN EDARC), at Pacific Institute for Research and Evaluation (PIRE), Calverton, MD, February 2014. Incidence based on 2011 data from the state and obtained from the South Carolina State Inpatient Databases (SID), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ), and the South Carolina Budget & Control Board (Columbia, SC). These injuries exclude patients who were dead at the time of discharge, readmission cases, transfers (e.g., from another short or long-term care facility, different acute care hospital), medical misadventures, and/or who suffered non-acute injuries. Although our analysis also removes suspected rehabilitation cases, we may miss some of these cases. All counts were based on the patients' state of residence. Most states in this fact sheet series contain data from the majority of hospitals in their respective state. However, several states are missing data from hospitals in their state. To find out more about state and hospital completeness, please visit http://www.hcup-us.ahrq.gov/db/state/siddist/2011SID_Dschge_HospCtsRptCD051912.pdf. Population statistics (Ages <1 - 24 years): United States Department of Health and Human Services (US DHHS), Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS), Bridged-Race Population Estimates, United States July 1st resident population by state, county, age, sex, bridged-race, and Hispanic origin. Retrieved from: http://wonder.cdc.gov/bridged-race-v2012.html. Note. **** = indicates that the cell value ranges from 1-10. Cells with no data have been deleted to prevent the addition/subtraction of data in a given row that would compromise the value of cells with a value of ****. Row and column totals that are in bold reflect the actual totals for a given incidence category. Row and/or column totals that are not in bold and include either a value of **** or a missing cell do not necessarily reflect the actual total for a given incidence category. Totals may not add due to rounding and/or cases with missing age data.

Suggested links: CSN: http://www.childrenssafetynetwork.org/ HCUP: http://www.hcup-us.ahrq.gov/home.jsp
PIRE: http://www.pire.org AHRQ: http://www.ahrq.gov/

CHAPTER III METHODOLOGY

3.1 Research Design or Method

This will be a quantitative study using retrospective analysis of archival data from South Carolina 2018 emergency room visits and hospital discharge data. The data will reflect all discharges for unintentional injuries in children age 0 to 19 from hospitals in South Carolina. Unintentional injury will be the principle baseline to identify types of injuries. The definition of unintentional injuries used in this study is physical damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of such essentials as heat or oxygen deprivation not done deliberately to oneself or by another person (Espitia-Hardeman & Paulozzi, 2005).

3.2 Sample Selection

Unintentional injury cases will be identified through hospital discharge population-based surveillance system data. Hospitalization and ER discharge data use ICD-10 E-codes definitions to identify the mechanism of injury and external causes of injury. The mechanism of injury will be defined by ICD-10 E-codes for the leading causes of unintentional injury for children ages 0-19 published by the World Health Organization and Centers for Disease Control and Prevention: motor vehicle related injuries, fires and burns, falls, drowning, poisoning and suffocation. Demographics in the study will be population-based data comprised of age, race, sex, geographic location (urban/rural), and payor.

3.3 Instrumentation

This study will analyze unintentional injuries using the Healthcare Cost and Utilization Project (HCUP) database sponsored by the Agency for Healthcare Research and Quality (AHRQ) and the International Classification of Diseases Classification of Diseases10th Revision (ICD-10) E-codes.

- **Healthcare Utilization Project, Agency for Healthcare Research and Quality (AHRQ)**: The AHRQ sponsors a Federal-State-Industry partnership, known as HCUP, which includes the largest collection of health care databases and associated software and products in the country, including the State Inpatient Databases SID and State Emergency Department Databases (SEDD) from collaborating states. The Healthcare Cost and Utilization Project (HCUP) databases bring together the data collection efforts of State data organizations, hospital associations, private data organizations, and the Federal government to create a national information resource of discharge-level health care data (AHRQ, 2017).
- **International Classification of Diseases10th Revision (ICD-10):** The ICD-10 is a diagnostic and procedural coding system used worldwide for systematic recording, analysis, interpretation, and comparison of morbidity and mortality data. Mechanism and cause of injury are based on ICD-10 external cause of injury codes (E-codes). The CDC's National Center for Injury Prevention and Control (NCIPC) uses these data to build the online query system Web-based Injury Statistics Query and Reporting System (WISQARS). WISQARS is an interactive, online database that

provides data related to fatal and nonfatal injury, violent death, and cost of injury from a variety of sources (CDC & NCHS, 2019; WISQARS & CDC, 2015).

3.4 Data Set Description

HCUP data will be examine by Age Group: 1 (0-364 days), Age Group 2 (1-4 years), Age Group 3 (5-9 years), Age Group 4 (10-14 years) Age Group 5 (15-19 years) (AHRQ, 2017). ICD-10 E-codes for unintentional injury/death categories that will be analyzed are listed in Table 10 (*a complete list of all codes can be found in Figure 7 in the Appendix A*).

Table 10. Unintentional Injury ICD-10 External Cause-of-Injury Codes	
Drowning/Submersion	**W65-W74,V90,V91**
Falls	**W00-W19**
Fire/Burns/Scald	**X00-X08, X10-X19**
Suffocation	**T71**
Poisoning	**T36-T50**
Subgroup: Poisoning by Animal	**T63**
Subgroup: Poisoning by Food/Plant	**T43.611, T61,T62, T63**
Subgroup: Poisoning by Medication/Drugs	**T36, T37, T38, T39, T40,T41, T42, T43, T44, T46, T47, T48, T50**
Subgroup: Poisoning by Toxic/Chemical Agents	**T51, T52, T53, T54, T55, T57, T58, T59, T60, T65**
Motor Vehicle Traffic Accidents, Pedestrian and Occupant Involving: 2,3 & 4 Wheeled Vehicles	
Motor Vehicle Traffic Accidents	**V00, V02-V4, V09, V20-V79**
Subgroup: ATV	**V86**
Subgroup: Bicycle (Pedal cyclist)	**V01, V10-V19**
Subgroup: Other Land Transport	**V80-V85, V87-V89, V91, V93-V96, V99**
Other Injury Groups: W23-W49, W85,W86,W88,W89,V05,V06,V91,V93-V98	
Cut/Pierce	**W25-W27**
Exposure: Electric, Radiation Temperature or Pressure	**W85, W86, W88, W89, W90**
Fire Arm	**W32, W33, W34**
Mechanical Forces: Inanimate/Animate Ojects	**W23, W24, W28-W31, W35-W40, W45,W46,W49**
Natural/Environmental	**W42, W53-W64, W92-W94, W99, X30-X39, X52, X58**
Overexertion	**X50**
Struck By: Striking, Hitting, Pushed or Crushed	**W20-W22, W50-W52**
Source: ICD-10 CM 2020, Practice Management Information Corporation (PMIC) and WHO. (CDC & NCHS, 2019)	

3.5 Independent and Dependent Variables

Variables will include patient number, injury type, age, race, sex. Unintentional Injury categories ICD-10 E-code data from hospitals surveillance system will be crossmatched with HCUP data to provide clinical disposition for length of stay (LOS), payor type, county of residence, total cost, and morbidity and mortality data (injury type).

3.5a Measures

The definition and classification of unintentional injury in this study is in accordance with the codes for external causes of injury from ICD-10 E-codes. These causes include the fundamental subsets of leading unintentional injuries published by the WHO and CDC/NCHS National Center for Injury Prevention and Control. Pathological injuries resulting from trauma or complication of an acute conditions are considered sequelae injuries. For the purpose of the study injury ICD-10 E-codes and their sequelae subsets are included and defined as any abnormality, chronic condition or complications consequence following or resulting from a disease or injury related to trauma treatment.

3.5b Unintentional Injury Categories Definitions (sequelae included)

- **Burn/Scald:** Asphyxia or poisoning due to conflagration or ignition, burning by fire, secondary fires resulting from explosion; damage caused by hot substance/object, caustic/corrosive material, and steam.
- **Cut/Pierce:** Injury caused by cutting and piercing instruments or objects, such as power tools, knives, or glass.
- **Drowning/Submersion:** Injury caused by cutting lack of oxygen resulting from insufficient air and ingestion of water.

- **Falls:** Injury caused by a fall from different levels or the same level, such as tripping, stumbling, fainting; also includes jumping.
- **Motor Vehicle Occupant (MVO):** Injury caused by a collision on a public street or roadway harming vehicle occupants.
- **Pedestrian-Related**: Injury caused by a collision on a public street or roadway harming pedestrians; collision in private spaces such as driveways or parking lots harming pedestrians.
- **Bicycle-Related:** Injury caused by a collision on a public street or roadway harming bicyclists; collision in private spaces such as driveways or parking lots harming bicyclists, or damaging spills by bicyclists without motor vehicle involvement.
- **Other Transport:** Injury caused by an incident involving other means of transportation, such as trains, planes, boats, or buses to persons other than pedestrians or bicyclists.
- **Natural/Environmental:** Injury caused by excessive heat or cold, lightning, or other environment factors; includes animal bites & insect bites and stings.
- **Overexertion:** Injury caused by excessive physical and/or strenuous movements.
- **Struck By:** Injury caused by striking against a blunt object or by a person.
- **Suffocation:** Injury caused by the inhalation or ingestion of objects causing obstruction of the respiratory tract.
- **Poisoning**: Injury caused by poisoning is any substance, including medications, that is harmful to your body if too much is eaten, inhaled, injected, or absorbed

through the skin. An unintentional poisoning occurs when a person taking or giving too much of a substance did not mean to cause harm including non-drug poisoning.

3.6 Data Analysis

ICD-10 E-coded unintentional injury mortality data will be electronically obtained for South Carolina Hospital Discharge year 2018 from the HCUP database. Unintentional injury categories will be analyzed to identify ER visits and hospital discharges by leading cause of injury by county for motor vehicle related accidents, drownings, poisonings, burns and falls and suffocations. Trends will be calculated to assess age-specific and injury type-specific components by county. Empirical data used will categorize identifiable demographical areas for high-risk populations per injury/trauma type for comparison across county, age groups, cost, payor and frequent injury.

Analysis should indicate determinants of injuries for the major cause of childhood mortality, morbidity, and disability for the purpose of planning, implementation, and evaluation of unintentional injury prevention practices. Results estimate rate distributions and compares likelihood of specific types of accidents by age groups, race/ethnicity, sex/gender, and high-risk locations statewide. Analysis will also reflect the economic burdens of unintentional injury related to medical expenditures (i.e. cost of medical and hospital treatment) for children age 0-18 generated from ER and hospital visits.

Statistical analysis of the data will provide pertinent information to support a comprehensive evaluation of injury determinants for specific counties and demographics on the cost and variations in trauma types for pediatric patients. Results can be used to determine

appropriate evidence-based best-practices for specific demographic areas or counties and high-risk populations. Findings from this study can provide a more precise way of choosing the most effective injury prevention strategies and interventions for targeted populations. This methodology can potentially enhance the state's ability to affect childhood morbidity and mortality rate across all population groups. In addition, it can assist pediatric ER staff to better navigate resources required for medical care and treatment of pediatric trauma patients.

CHAPTER IV RESULTS

4.1 Results/Findings

Descriptive statistics for unintentional injury characteristics and key variables (demographics, injury groups, payor mix, and total charges/payments) for a three-year range from 2016 to 2018 are shown in Table 11. Categorical data comparisons were performed using the chi-square test or when expected cell frequencies were <5, Fisher's Exact test. Non-parametric testing (Wilcoxon rank-sum test) was performed when continuous data were not normally distributed. Significance was defined as $p<0.05$. According to Data Use Agreement cells with <10 observations were suppressed, <10 is represented in those specific cells. A total of 41,183 children between the ages of 0 and 19 had an emergency room visit or hospital discharge in the years 2016, 2017 and 2018 for an unintentional injury. Males were over-represented for each year studied, comprising 55.6% in 2016, 54.8% in 2017, and 55.3% in 2018. The age groups with the highest number of injuries were 15 to 19 years of age 11,874 (28.8%) and 1 to 4 years of age 10,625 (25.8%). Race distribution showed blacks ranked highest 19,850 (48.2%), then whites 18,680 (45.4%), Hispanic 1,266 (3.1%), and all others 1,351 (3.3%).

Mortality was significantly low representing 14 over the three years, of which half (7) of the deaths occurred in 2016. Consequently, more unintentional injuries requiring emergency care occurred in 2016 (n=15,324). The top three most common injuries were poisoning 10,467 (25.4%), natural/environmental 9,531 (23.1%) and falls 7,702 (18.7%) showing no major significant differences over the three years $p<.0001$. However, natural/environmental was significantly higher in 2016, accounting for 4,131 (27.0%) injuries compared to 2017=2,787 (22.1%), 2018=2,613 (19.7%). Overall, transportation accounted for 5,810 (14.1%) and Struck-

By (accidental striking, hitting, pushed or crushed) accounted for 5,961 (14.5%) which showed slight differences over the three years with 2016 remaining an outlier with the highest total of the three years. Across payor mix, Medicaid paid for a total of 22,673 (55.1%) incidents covering payments for over half of the injury events. The mean and standard deviation for total charges and ER payments remained static over the three-years ($p<.0001$).

Table 12 shows unintentional injury emergency room visits and hospital discharge classified by metropolitan (urban) and non-metropolitan (rural) counties. Metropolitan counties had a total of 24,283 and non-metropolitan counties accounted for 16,901. There were no significant differences across the age groups for metropolitan and non-metropolitan counties except for a higher frequency in age groups 1 to 4 years of age 6,898 (28.4%) and 15 to 19 years of age 6,872 (28.8%) $p<.0001$. Age group 15 to 19 had a significantly higher frequency in non-metropolitan counties 5,002 (29.6%) than all other age groups. Distribution by injury types showed poisoning injuries were highest in metropolitan counties 8,439 (34.8%) and nature/environmental were highest in non-metropolitan counties 4,858 (28.7%). Race was equitably distributed among blacks 10,323 (42.6%) and whites 11,901 (49.1%) in metropolitan counties $p<.0001$. Non-metropolitan counties had a much higher minority population distribution for blacks 9,527 (56.4%) compared to whites 6,779 (40.1%). Medicaid was the highest payor, however the number of incidents covered was evenly distributed for both metropolitan 13,330 (54.9) and non-metropolitan 9,343 (55.3%) $p<.0001$. Private payors paid coverage for incidents represented in metropolitan 4,921 (20.3%) and non-metropolitan 2,939 (17.4%). Mean and standard deviation for total charges was higher for metropolitan $2,905 \pm 9,302$ than for non-metropolitan $1,824 \pm 3,860$ $p<0.0001$.

Table 11. Unintentional Injury Characteristics for a three-year rage from 2016 to 2018 of demographics, injury groups, payor mix, and total charges/payments.

Characteristic	Total n=41,183	2016 n=15,324	2017 n=12,587	2018 n=13,272	p-value[1]
Demographics	**N (%)**				
Male	22,747 (55.24)	8,517 (55.6)	6,891 (54.8)	7,339 (55.3)	0.3679
Patient Age Group					<0.0001
Less than one year old	1,298 (3.2)	467 (3.1)	419 (3.3)	412 (3.1)	
1-4 years old	10,625 (25.8)	3,748 (24.5)	3,381 (26.9)	3,496 (26.3)	
5-9 years old	8,687 (21.1)	3,360 (21.9)	2,620 (20.8)	2,707 (20.4)	
10-14 years old	8,699 (21.1)	3,271(21.4)	2,640 (21.0)	2,788 (21.0)	
15-19 years old	11,874 (28.8)	4,478 (29.2)	3,527 (28.0)	3,869 (29.2)	
Race					<0.0001
Black	19,850 (48.2)	7,528 (49.2)	6,107 (48.6)	6,215 (46.8)	
Hispanic	1,266 (3.1)	420 (2.7)	445 (3.5)	401 (3.0)	
White	18,680 (45.4)	6,914 (45.2)	5,636 (44.8)	6,130 (46.2)	
Other	1,351 (3.3)	440 (2.9)	389 (3.1)	522 (3.9)	
Study Variables	**N (%)**				
Mortality	14 (0.0)	<10 (0.1)	<10 (0.0)	<10 (0.0)	
Injury Type[2]					
Poisoning	10,467 (25.4)	3,643 (23.8)	3,461 (27.5)	3,363 (25.3)	<.0001
Natural/Environmental[3]	9,531 (23.1)	4,131 (27.0)	2,787 (22.1)	2,613 (19.7)	<.0001
Fall	7,702 (18.7)	2,707 (17.7)	2,374 (18.9)	2,621 (19.8)	<.0001
Struck By[4]	5,961 (14.5)	2,139 (14.0)	1,825 (14.5)	1,997 (15.1)	0.0332
Transportation	5,810 (14.1)	2,083 (13.6)	1,747 (13.9)	1,980 (14.9)	0.0039
Mechanical Forces[5]	1,403 (3.4)	508 (3.3)	428 (3.4)	467 (3.5)	0.6381
Cut/Pierce	968 (2.4)	255 (1.7)	303 (2.4)	410 (3.1)	<.0001
Burn	276 (0.7)	112 (0.7)	63 (0.5)	101 (0.8)	0.0189
Overexertion	131 (0.3)	11 (0.1)	70 (0.6)	50 (0.4)	<.0001
Firearm	88 (0.2)	29 (0.2)	32 (0.3)	27 (0.2)	0.4807
Exposure[6]	42 (0.1)	14 (0.1)	15 (0.1)	13 (0.1)	0.7573
Drowning	14 (0.0)	<10 (0.0)	<10 (0.1)	<10 (0.0)	
Suffocation	<10 (0.0)	<10 (0.0)	0 (0.0)	<10 (0.0)	
Payor					<0.0001
Medicaid	22,673 (55.1)	8,742 (57.1)	6,925 (55.0)	7,006 (52.8)	
Medicare	990 (2.4)	158 (1.0)	228 (1.8)	604 (4.6)	
Private	7,860 (19.1)	2,904 (19.0)	2,352 (18.7)	2,604 (19.6)	
Self	3,796 (9.2)	1,414 (9.2)	1,258 (10.0)	1,124 (8.5)	
Other	5,864 (14.2)	2,106 (13.7)	1,824 (14.5)	1,934 (14.6)	
Cost of Care	**Mean ± SD in Dollars**				
Total Charges	2,461 ±7,577	2,335 ±6,960	2,469 ±6,641	2,600 ±8,964	<0.0001
ER Payments	1,087 ±906	1,049 ±842	1,145 ±897	1,077 ±979	<0.0001

[1]Significance testing: Chi square for categorical and Kruskal-Wallis test for continuous variables.
[2]Patients may have more than one injury type per observation. E.g., a transportation injury with a burn injury.
[3]Natural/Environmental: Accidental exposure to forces of nature and other specified environmental factors.
[4]Struck-By: Accidental Striking, Hitting, Pushed or Crushed.
[5]Mechanical Forces: Exposure to inanimate or animate mechanical forces.
[6]Exposure: Exposure to electric current, radiation and extreme ambient air temperature and pressure.

Table 12. Metropolitan/Non-Metropolitan Classification (Urban/Rural)

Characteristic	Total n= 41,183	Metropolitan n=24,282	Non-Metropolitan n=16,901	p-value[1]
Demographics		**N (%)**		
Male	22,747 (55.2)	13,402 (55.2)	9,345 (55.3)	0.8402
Patient Age Group				<.0001
Less than one year old	1,298 (3.2)	840 (3.5)	458 (2.7)	
1-4 years old	10,625 (25.8)	6,898 (28.4)	3,727 (22.1)	
5-9 years old	8,687 (21.1)	4,859 (20.0)	3,828 (22.7)	
10-14 years old	8,699 (21.1)	4,813 (19.8)	3,886 (23.0)	
15-19 years old	11,874 (28.8)	6,872 (28.3)	5,002 (29.6)	
Race				<.0001
Black	19,850 (48.2)	10,323 (42.6)	9,527 (56.4)	
Hispanic	1,266 (3.1)	1,083 (4.5)	183 (1.1)	
White	18,680 (45.4)	11,901 (49.1)	6,779 (40.1)	
Other	1,351 (3.3)	943 (3.9)	408 (2.4)	
Study Variables		**N (%)**		
Mortality	14 (0.0)	11 (0.1)	<10 (0.0)	0.1356
Injury Type[2]				
Poisoning	10,467 (25.4)	8,439 (34.8)	2,028 (12.0)	<.0001
Natural/Environmental[3]	9,531 (23.1)	4,673 (19.2)	4,858 (28.7)	<.0001
Fall	7,702 (18.7)	4,143 (17.1)	3,559 (21.1)	<.0001
Struck-By[4]	5,961 (14.5)	3,059 (12.6)	2,902 (17.2)	<.0001
Transportation	5,810 (14.1)	2,800 (11.5)	3,010 (17.8)	<.0001
Mechanical Forces[5]	1,403 (3.4)	704 (2.9)	699 (4.1)	<.0001
Cut/Pierce	968 (2.4)	529 (2.2)	439 (2.6)	0.0058
Burn	276 (0.7)	130 (0.5)	146 (0.9)	<.0001
Overexertion	131 (0.3)	27 (0.1)	104 (0.6)	<.0001
Drowning	14 (0.0)	12 (0.1)	<10 (0.0)	0.0418
Firearm	88 (0.2)	35 (0.1)	53 (0.3)	0.0002
Exposure[6]	42 (0.1)	19 (0.1)	23 (0.1)	0.0705
Suffocation	<10 (0.0)	<10 (0.0)	0 (0.0)	
Payor				<.0001
Medicaid	22,673 (55.1)	13,330 (54.9)	9,343 (55.3)	
Medicare	990 (2.4)	573 (2.4)	417 (2.5)	
Private	7,860 (19.1)	4,921 (20.3)	2,939 (17.4)	
Self	3,796 (9.2)	2,326 (9.6)	1,470 (8.7)	
Other	5,864 (14.2)	3,132 (12.9)	2,732 (16.2)	
Cost of Care		**Mean ± SD in Dollars**		
Total Charges	2,461 ±7,577	2,905 ±9,302	1,824 ±3,860	<0.0001
ER Payments	1,087 ±906	1,186 ±943	945 ±829	<0.0001

[1]Significance testing: Chi square for categorical and Wilcoxon Signed-Rank test for continuous variables.
[2]Patients may have more than one injury type per observation. E.g., a transportation injury with a burn injury.
[3]Natural/Environmental: Accidental exposure to forces of nature and other specified environmental factors.
[4]Struck-By: Accidental Striking, Hitting, Pushed or Crushed.
[5]Mechanical Forces: Exposure to inanimate or animate mechanical forces.
[6]Exposure: Exposure to electric current, radiation and extreme ambient air temperature and pressure.

Table 13 shows the top five counties with the highest number of emergency room visits and hospital discharge for unintentional injuries. The total column represents the number of visits for the five counties with the highest number of injury events. Beaufort County had the highest total amount of 6,837. The next highest counties were Orangeburg 5,664, and Cherokee 5,184. There were no significant differences across age groups ($p<.0001$), nor race ($p<.0001$). Chester and Georgetown counties had the lowest numbers across all age groups. Beaufort had the highest number of falls 2,050 (30%) while Cherokee (46.3%), Chester (27.7%) and Orangeburg (23.4%) had a high percentage of nature/environmental exposures comparable to all other injury types. Injury types with the lowest frequency were drowning, exposure, firearm, and overexertion. Mean and standard deviation for ER payments was lowest for Cherokee (757 ± 455) and Georgetown (550 ± 458).

Table 14 shows the top five counties with the highest risk by population rate percent per injury. The total column represents the number of visits for the five counties with the highest population rate percent per injury. Chester (40%) and Cherokee (39%) had the highest percent of the five counties. Males represent over 50% of injury events in all five counties. There were no significant differences across age groups and race $p<.0001$. Cherokee 3,229 (62.3%) had the largest population and percent of whites. Orangeburg 4,142 (73.1%), Williamsburg 1,317 (83.4%) and Fairfield 711 (78.2%) had a larger population and percent of blacks. Natural/environmental 5,111 (31.5%) had the highest frequency/percent for all five counties. Although there was no significant difference for total charges and ER payments $p<.0001$, Williamsburg (388 ± 244) had the lowest mean and standard deviation for ER payments.

Poisoning represented the highest frequency across all injury types. Table 15 shows poisoning by subgroups. Occurrence remained static over the three years with significant

variance per subgroup p<0.0518. More children were poisoned by animals 3,878 (37.1%), medication 3,254 (31.1%) and toxic/chemical agents 2,060 (19.7%) than any of the other poisoning subgroups. There was no significant difference for mean and standard deviation of total charges and ER payments p<.0001. Table 16 shows transportation by subgroups which includes all-terrain vehicles (ATV), bike and motor vehicle p<0.3224. An overall total of 5,716 transportation injuries occurred, 2016 had the highest number of events for a total of 2,033. More injuries occurred by motor vehicle 4,931(86.3%) with fewer occurrences by bike 448 (7.8%) and ATV 337 (5.9%).

Table 13. Top Five Counties with the Highest Number of Injury Events

Characteristic	Total n=22,367	Beaufort n=6,837	Orangeburg n=5,664	Cherokee n=5,184	Chester n=2,901	Georgetown n=1,781	p-value[1]
Demographics	**N (%)**						
Male	1,2427 (55.6)	3,843 (56.2)	3,208 (56.6)	2,776 (53.6)	1,601 (55.2)	999 (56.1)	0.0129
Patient Age Group							<.0001
Less than one year old	711 (3.2)	296 (4.3)	138 (2.4)	168 (3.2)	72 (2.5)	37 (2.1)	
1-4 years old	4,887 (21.9)	1,705 (24.9)	1,107 (19.5)	1,105 (21.3)	587 (20.2)	383 (21.5)	
5-9 years old	5,164 (23.1)	1,497 (21.9)	1,365 (24.1)	1,192 (23.0)	724 (25.0)	386 (21.7)	
10-14 years old	5,148 (23.0)	1,434 (21.0)	1,331 (23.5)	1,185 (22.9)	781 (26.9)	417 (23.4)	
15-19 years old	6,457 (28.9)	1,905 (27.9)	1,723 (30.4)	1,534 (29.6)	737 (25.4)	558 (31.3)	
Race							<.0001
Black	11,386 (50.9)	2,978 (43.6)	4,142 (73.1)	1,771 (34.2)	1,617 (55.7)	878 (49.3)	
Hispanic	767 (3.4)	624 (9.1)	141 (2.5)	0 (0.0)	<10 (0.1)	0 (0.0)	
White	9,662 (43.2)	3,007 (44.1)	1,316 (23.2)	3,229 (62.3)	1,262 (43.5)	848 (47.6)	
Other	538 (2.4)	216 (3.1)	64 (1.1)	184 (3.6)	20 (0.7)	54 (3.0)	
Study Variables	**N (%)**						
Mortality	<10 (0.0)	0 (0.0)	<10 (0.0)	<10 (0.0)	0 (0.0)	0 (0.0)	0.7036
Injury Type[2]							
Natural/Environmental[3]	6,798 (30.4)	1,893 (27.7)	1,327 (23.4)	2,401 (46.3)	804 (27.7)	373 (20.9)	<.0001
Fall	5,668 (25.3)	2,050 (30.0)	1,288 (22.7)	1,212 (23.4)	669 (23.1)	449 (25.2)	<.0001
Transportation	4,124 (18.4)	1,033 (15.1)	1,231 (21.7)	907 (17.5)	662 (22.8)	291 (16.3)	<.0001
Struck-By[4]	3,804 (17.0)	1,153 (16.9)	1,019 (18.0)	905 (17.5)	411 (14.2)	316 (17.7)	0.0002
Poisoning	1,038 (4.6)	356 (5.2)	255 (4.5)	192 (3.7)	86 (3.0)	149 (8.4)	<.0001
Mechanical Forces[5]	924 (4.1)	220 (3.2)	298 (5.3)	151 (2.9)	151 (5.2)	104 (5.8)	<.0001
Cut/Pierce	648 (29.0)	199 (2.9)	152 (2.7)	137 (2.6)	94 (3.2)	66 (3.7)	0.1131
Burn	171 (0.8)	62 (0.9)	38 (0.7)	42 (0.8)	13 (0.5)	16 (0.9)	0.1429
Overexertion	113 (0.5)	<10(0.1)	20 (0.4)	75 (1.5)	11 (0.4)	<10 (0.1)	<.0001
Firearm	64 (0.3)	13 (0.2)	31 (0.6)	13 (0.3)	<10 (0.2)	0 (0.0)	0.0003
Exposure[6]	29 (0.1)	<10 (0.1)	11 (0.2)	<10 (0.1)	<10 (0.1)	<10 (0.1)	0.6467
Drowning	<10 (0.0)	<10 (0.0)	<10 (0.0)	<10 (0.0)	<10 (0.1)	0 (0.0)	0.5324
Suffocation	0	0	0	0	0	0	
Payor							<.0001
Medicaid	12,023 (53.8)	3,353 (49.0)	2,040 (36.0)	3,563 (68.7)	2,045 (70.5)	1,022 (57.4)	
Medicare	388 (1.7)	71 (1.0)	156 (2.8)	<10 (0.1)	36 (1.2)	119 (6.7)	
Private	3,857 (17.2)	1,021 (14.9)	995 (17.6)	904 (17.4)	614 (21.2)	323 (18.1)	
Self	1,762 (7.9)	567 (8.3)	498 (8.7)	389 (7.5)	132 (4.6)	181 (10.2)	
Other	4,337 (19.4)	1,825 (26.7)	1,980 (35.0)	322 (6.2)	74 (2.6)	136 (7.6)	
Cost of Care	**Mean ± SD in Dollars**						
Total Charges	2,046 ± 3,095	2,372 ± 3,720	2,195 ± 3,199	1,562 ± 2,308	2,175 ± 2,281	1,520 ± 3,032	<0.0001
ER Payments	1,110 ± 870	1,118 ± 690	1,369 ± 1,066	757 ± 455	1,561 ± 1,117	550 ± 458	<0.0001

[1]Significance testing: Chi square for categorical and Wilcoxon Signed-Rank test for continuous variables.
[2]Patients may have more than one injury type per observation. E.g., a transportation injury with a burn injury.
[3]Natural/Environmental: Accidental exposure to forces of nature and other specified environmental factors.
[4]Struck-By: Accidental Striking, Hitting, Pushed or Crushed.
[5]Mechanical Forces: Exposure to inanimate or animate mechanical forces.
[6]Exposure: Exposure to electric current, radiation and extreme ambient air temperature and pressure.

Table 14. Top Five High-Risk Counties by Population Rate Percent per Injury Event

Characteristic	Total n=16,243	Chester n=2,901 rate=40%	Cherokee n=5,184 rate=39%	Orangeburg n=5,664 rate=30%	Williamsburg n=1,580 rate=25%	Fairfield n=914 rate=21%	p-value[1]
Demographics	**N (%)**						
Male	8,969 (55.2)	1,601 (55.2)	2,776 (53.6)	3,208 (56.6)	875 (55.4)	509 (55.7)	0.0319
Patient Age Group							<.0001
Less than one year old	426 (2.6)	72 (2.5)	168 (3.2)	138 (2.4)	29 (1.8)	19 (2.1)	
1-4 years old	3,236 (19.9)	587 (20.2)	1,105 (21.3)	1,107 (19.5)	286 (18.1)	151 (16.5)	
5-9 years old	3,829 (23.6)	724 (25.0)	1,192 (23.0)	1,365 (24.1)	354 (22.4)	194 (21.2)	
10-14 years old	3,983 (24.5)	781 (26.9)	1,185 (22.9)	1,331 (23.5)	435 (27.5)	251 (27.5)	
15-19 years old	4,769 (29.4)	737 (25.4)	1,534 (29.6)	1,723 (30.4)	476 (30.1)	299 (32.7)	
Race							<.0001
Black	9,558 (58.9)	1,617 (55.7)	1,771 (34.2)	4,142 (73.1)	1,317 (83.4)	711 (78.2)	
Hispanic	153 (0.9)	<10 (0.1)	0 (0.0)	141 (2.5)	0 (0.0)	10 (1.1)	
White	6,242 (38.4)	1,262 (43.5)	3,229 (62.3)	1,316 (23.2)	252 (16.0)	183 (20.1)	
Other	284 (1.8)	20 (0.7)	184 (3.6)	64 (1.1)	11 (0.7)	<10 (0.6)	
Study Variables	**N (%)**						
Mortality	<10 (0.0)	0 (0.0)	<10 (0.0)	<10 (0.0)	<10 (0.0)	0 (0.0)	0.5926
Injury Type[2]							
Natural/Environmental[3]	5,111 (31.5)	804 (27.7)	2,401 (46.3)	1,327 (23.4)	387 (24.5)	192 (21.0)	<.0001
Fall	3,724 (22.9)	669 (23.1)	1,212 (23.4)	1,288 (22.7)	341 (21.6)	214 (23.4)	0.6479
Transportation	3,288 (20.2)	662 (22.8)	907 (17.5)	1,231 (21.7)	290 (18.4)	198 (21.7)	<.0001
Struck-By[4]	2,811 (17.3)	411 (14.2)	905 (17.5)	1,019 (18.0)	309 (19.6)	167 (18.3)	<.0001
Mechanical Forces[5]	733 (4.5)	151 (5.2)	151 (2.9)	298 (5.3)	91 (5.8)	42 (4.6)	<.0001
Poisoning	685 (4.2)	86 (3.0)	192 (3.7)	255 (4.5)	111 (7.0)	41 (4.5)	<.0001
Cut/Pierce	466 (2.9)	94 (3.2)	137 (2.6)	152 (2.7)	48 (3.0)	35 (3.8)	0.1797
Burn	133 (0.8)	13 (0.5)	42 (0.8)	38 (0.7)	33 (2.1)	<10 (0.8)	<.0001
Overexertion	116 (0.7)	11 (0.4)	75 (1.5)	20 (0.4)	<10 (0.4)	<10 (0.4)	<.0001
Firearm	57 (0.4)	<10 (0.2)	13 (0.3)	31 (0.6)	<10 (0.3)	<10 (0.2)	0.0474
Exposure[6]	26 (0.2)	<10 (0.1)	<10 (0.1)	11 (0.2)	<10 (0.2)	<10 (0.3)	0.4288
Drowning	<10 (0.0)	<10 (0.1)	<10 (0.0)	<10 (0.0)	0 (0.0)	0 (0.0)	0.5752
Suffocation	0	0	0	0	0	0	
Payor							<.0001
Medicaid	9,251 (57.0)	2,045 (70.5)	3,563 (68.7)	2,040 (36.0)	1,144 (72.4)	459 (50.2)	
Medicare	415 (2.6)	36 (1.2)	6 (0.1)	156 (2.8)	67 (4.2)	150 (16.4)	
Private	2,816 (17.3)	614 (21.2)	904 (17.4)	995 (17.6)	162 (10.3)	141 (15.4)	
Self	1,249 (7.7)	132 (4.6)	389 (7.5)	498 (8.7)	129 (8.2)	106 (11.6)	
Other	2,512 (15.5)	74 (2.6)	322 (6.2)	1,980 (35.0)	78 (5.0)	58 (6.4)	
Cost of Care	**Mean ± SD in Dollars**						
Total Charges	1,781 ± 2,629	2,175 ± 2,281	1,562 ± 2,308	2,195 ± 3,200	774 ± 1,617	941 ± 1,963	<0.0001
ER Payments	1,067 ± 927	1,561 ± 1,117	757 ± 455	1,369 ± 1,066	388 ± 244	560 ± 239	<0.0001

[1]Significance testing: Chi square for categorical and Wilcoxon Signed-Rank test for continuous variables.
[2]Patients may have more than one injury type per observation. E.g., a transportation injury with a burn injury.
[3]Natural/Environmental: Accidental exposure to forces of nature and other specified environmental factors.
[4]Struck-By: Accidental Striking, Hitting, Pushed or Crushed.
[5]Mechanical Forces: Exposure to inanimate or animate mechanical forces.
[6]Exposure: Exposure to electric current, radiation and extreme ambient air temperature and pressure.

Table 15. Poisoning Subgroup

Characteristic	Total n=10,467	2016 n=3,643	2017 n=3,461	2018 n=3,363	p-value[1]
	N (%)				
Subgroups					0.0518
Animal Poison	3,878 (37.1)	1,396 (38.3)	1,274 (36.8)	1,208 (35.9)	
Medication	3,254 (31.1)	1,060 (29.1)	1,108 (32.0)	1,086 (32.3)	
Toxic/Chemical	2,060 (19.7)	754 (20.7)	659 (19.0)	647 (19.2)	
Pain Killer	561 (5.4)	178 (4.9)	194 (5.6)	189 (5.6)	
Food or Plant	249 (2.4)	82 (2.3)	76 (2.2)	91 (2.7)	
Illegal Drug	245 (2.3)	86 (2.4)	77 (2.2)	82 (2.4)	
Opioid	220 (2.1)	87 (2.4)	73 (2.1)	60 (1.8)	
Cost of Care	**Mean ± SD in Dollars**				
Total Charges	3,222 ± 10,286	3,151 ±10,897	2,978 ± 8,398	3,551 ± 11,312	<0.0001
ER Payments	1,148 ± 938	1,083 ± 899	1,132 ± 906	1,235 ± 1,004	<0.0001

[1]Significance testing: Chi square for categorical and Kruskal-Wallis test for continuous variables. Column B (Total group) was not included in the tests for significance.

Table 16. Transportation Subgroup

Characteristic	Total n=5,716	2016 n=2,033	2017 n=1,727	2018 n=1,956	p-value[1]
	N (%)				
Subgroups					0.3224
Motor Vehicle	4,931 (86.3)	1,756 (86.4)	1,480 (85.7)	1,695 (86.7)	
Bike	448 (7.8)	169 (8.3)	142 (8.2)	137 (7.0)	
ATV	337 (5.9)	108 (5.3)	105 (6.1)	124 (6.3)	
Cost of Care	**Mean ± SD in Dollars**				
Total Charges	2,847 ±1,735	2,593 ±5,056	2,803 ±6,422	3,149 ±9,257	0.0005
ER Payments	1,069 ±1,136	1,020 ±1,060	1,158 ±1,167	1,042 ±1,178	<0.0001

[1]Significance testing: Chi square for categorical and Kruskal-Wallis test for continuous variables. Column B (Total group) was not included in the tests for significance.

CHAPTER V DISCUSSION

5.1 Discussion of Results

This study presented a retrospective analysis of cost and variations of trauma types for pediatric patients presenting to the emergency room for treatment of an unintentional injury. First, the study examined overall data for emergency room visits and hospital discharges for all 46 counties in South Carolina focusing on demographics, injury type, payor and cost of care. The study showed very little variation in the cost of care across the three-year spectrum between 2016 to 2018. However, further examination by location showed the overall cost was higher in metropolitan counties possibly due to high population density in urban cities located in metropolitan counties such as Richland, Charleston, and Greenville. Metropolitan counties are classified as *Urban* and Non-metropolitan counties are classified as *Rural* for purposes of this analysis.

The prevalence of injury by race was similar for blacks (48.2%) and whites (45.4%). Because of the large group sizes, there were very small differences in racial composition across the three years. However, there was a distinct difference by race for urban and rural counties. Injury events for whites (49.1%) were higher in urban counties than for blacks (42.6%). Injury events for blacks (56.4%) were higher in rural counties than for whites (40.1%) as shown in Table 12. This could primarily be attributed to the population representation for each county's race demographic. Kids Count Data Center was used to estimate the distribution by race for children under the age of 18 shown in Table 18. There was a notable disparity by race for South Carolina total population count for children under the age of 18. The analysis by race showed a higher percent representation for whites (57%) than blacks (32%) and Hispanic/other (11%) (kidscount.com, 2019).

Analysis of the top five counties by the number of injury and risk was higher for blacks (Injury= 50.9%, Risk=58.9%) than for whites (Injury=43.2%, Risk=38.4%) shown in Table 13 and 14. Numerous literature support findings reporting minority children to be at higher risk from accidental injury, especially among those living in rural areas. There was no surprise that Medicaid topped the list as the leading payor, as it is the primary insurer for children ages 0 to 19. Most children ages 0-19 in South Carolina are enrolled in the state's Medicaid program or the South Carolina Children's Health Insurance Program (CHIP). CHIP is a federally- and state-funded program that provides low-cost health coverage to children in families that earn too much money to qualify for Medicaid yet cannot afford to buy private health insurance (SCDHHS, 2019). This aligns with the literature identifying Medicaid as the primary payor for children and private payors as secondary for children insured by parent's employer coverage. Subsequently, the State Medicaid program and private insurers would greatly benefit from a decrease in the number of injury events. There were almost a thousand payments by Medicare (n=990). Medicare can be used to supplement health coverage for your child if they are under the age of 22 and qualify for Medicare because of a serious illness or disability. The total number of Medicare payments gives us insight in the representation of children with special needs who are presentation to the ER for injuries.

5.1a Injury Variation by Trauma Types

The study examined variation in trauma types by identifying the frequency of injury by mechanism. First, it is important to note the literature identified childhood development as a contributing factor for trauma type by specific age groups. Overall, injuries were generally evenly distributed by age groups except for age group "less than one year old" which represented a very low 3.2%. This under-representation may be the result of how infants are coded related to the classification of the type of injury associated with wound or injury location

on or to the body as opposed to mechanism or caused. For example, an infant may fall from the bed and break a wrist; he or she may receive an “S62” ICD-10 code for a fracture at the wrist and hand level instead of a “W09” ICD-10 code for fall from a bed.

The study found that children in age groups 1 to 4 years old and 15 to 19 years old had the highest frequency of injury events. This finding is supported by literature reporting that children in age group 1 to 4 are at the appropriate childhood development stage for beginning to crawl, walk, run, climb, and jump. These activities make this age group more prone to injury as they actively explore their environment. Children in the age group 15 to 19 are becoming more independent and social, starting to drive, and are gradually exposed to more risky situations in their teenage years. Age groups 5 to 9 years old and 10 to 14 years old tied at 21.1%. This is the age where children are theoretically impacted by injuries as a result of perception and cognitive development while learning and playing in interactive modifiable environments.

The study showed a surprisingly high trauma type frequency for poisoning, natural/environmental and falls than any other injury mechanism. Numerous literatures support this finding showing falls and natural/environmental injuries were more common due to childhood engagement in indoors and outdoors activities. The high frequency of poisoning was extremely surprising and a significant finding in the study. South Carolina Palmetto Poison Center reported receiving calls ranging from poisonous substance to medication and chemical/toxic exposure with over 50 % of calls involved children exposed to poisonous materials. Therefore, I decided to take a closer look at poisoning by subgroups to determine variation by poisoning type shown in Table 15. The subgroups were separated for poisoning by an animal, chemical/toxic, food or plant, illegal drugs, medication, opioid, and non-opioid pain killers.

The subgroup analysis revealed 37.1% poisoning by animals speculating an increased probability of unsupervised child encounters with venomous animals (i.e. snakes, jellyfish, wasps, spiders, reptiles) and exposure to insects or animal bites. Medication poisoning accounted for 31.1% of poisoning which is supported by literature indicating a large percentage of emergency room visits for young children are a result of unsupervised children getting into medication not properly stored in a secured location. The American Association of Poison Control Centers recommends all potential poisons (i.e. toxic/chemical, medication) should be kept up high and out of reach or under a lock and key. Studies by state health agencies have also reported recent increases in medication and prescription drug poisoning.

5.1b County Rank: Number of Injury versus Population Rate Percent (High-Risk)

The Children's Safety Network suggested that one way to better understand disparities is to look at the rate of injuries by place of occurrence. Table 17 (Appendix) was constructed to establish a ranking order of all 46 counties from greatest to least by population rate percent or high-risk population and by the number of injuries. Population rate percent was calculated by dividing the total number of injuries by the total population of children under the age of 18 years of age for each county. County population data was retrieved from the Kids Count Data Center website (kidscount.com, 2019).

The top five counties with the highest number of injuries were Beaufort (Urban), Orangeburg (Rural), Cherokee (Rural), Chester (Urban) and Georgetown (Rural) shown in Table 13. The top five counties with the highest population rate percent and identified as the highest risk counties were Chester (Urban), Cherokee (Rural), Orangeburg (Rural), Williamsburg (Rural) and Fairfield (Urban) shown in Table 14 This part of the analysis

determined that injuries in the top five counties occurred more frequently in rural counties than in urban counties. Three out of the five counties listed in the top five counties analysis for number of injury and high-risk were identified as rural counties. This finding is consistent with the literature reporting children living in rural areas are at greater risk from accidental injury-related death than children living in urban areas.

5.2 Limitations

Findings in this study were subjected to at least three limitations. First, patients may have more than one or a combination of injuries per emergency room visit or observation. This may over or underestimate the data resulting in misclassification of injury by mechanism. Subsequently, the descriptive analysis would identify multiple injury/cause which may require further detailed analysis. For example, a child may present to the ER for a fall from a bike after being struck by a car and sustained a head injury. Second, the truthfulness of the parents reporting an injury and the true circumstances of the incident to avoid mandatory child welfare reporting prompting an investigation by child protective services. This can also be the case when children especially teenagers are not honest about the true cause or circumstances of an incident. Third, the surveillance systems data and hospital reporting practice by the health practitioners has many variable factors.

1. The surveillance systems data are only as accurate as data imputed by the health practitioners.

2. Training, curriculums, and guidelines for using ICD-10 and E-codes may vary depending on the practitioner's experience level.

3. Inadequate or limited documentation on the medical record may influence an incorrect assignment of injury codes. Frequently there is inadequate information to determine injury cause. The type of injury and the external cause of the injury are manually coded using the narrative description of the incident. The better the description of the incident, the more accurate the coding will be.

4. Data limitation may exclude the accountability of practitioner's bias or omissions in certain data fields due to the stigmatization of certain groups. For example, physicians and coders are concerned about labeling persons and may have unconscious biases which influence documentation and coding because child abuse, rape, and suicide could be considered controversial.

5. In the event of an injury under investigation where the cause cannot be determined, hospital personnel is restricted from using the undetermined cause of injury codes which forces them to code injuries as intentional or unintentional even when it is questionable.

5.3 Future Research

This study adds to the body of literature related to childhood injury. Research on follow-up care after discharge or readmission may help determine better interventions required to prevent reoccurrences. It would be interesting to research the rate of hospital admission and length of stay for children admitted for unintentional injury beyond 24- or 48-hours observation by type of injury for South Carolina hospitals. A case analysis study could offer greater insight for high-cost injuries to investigate opportunities to reduce overall expenditures related to the total cost of care and treatment options. Previous studies have been done on the overall surveillance systems to improve documentation on medical records and standardized guidelines and training for ICD-10 and E-coding. Such guidelines were implemented during the conversion protocol process when transitioning from ICD-9 to the updated ICD-10 coding system.

5.4 Conclusion

Injuries are a common occurrence for children but when it requires a visit to the emergency room, hospitalization or death, something has to be done to decrease these occurrences. Unintentional injuries are the leading cause of death for children age 0 to 19. Fortunately, unintentional injuries are preventable with targeted interventions. Many effective

strategies and evidence-based best practices are available to reduce childhood injury and mortality. Overall analysis for South Carolina by county identified Chester, Cherokee and Orangeburg counties as the three counties overlapping in both high-risk and the high number of injury occurrences. These three counties should be targeted first for any intervention rollout followed by Williamsburg, Fairfield, Beaufort, and Georgetown counties.

Interventions for each county should be concentrated on the injury types with the highest frequency:

- Chester County: Natural/Environmental, Falls, Transportation, Struck-By
- Cherokee County: Natural/Environmental, Falls, Transportation, Struck-By
- Orangeburg County: Natural/Environmental, Falls, Transportation, Struck-By
- Williamsburg County: Natural/Environmental, Falls, Struck-By, Transportation
- Fairfield County: Falls, Transportation, Natural/Environmental, Struck-By
- Beaufort County: Falls, Natural/Environmental, Struck-By, Transportation
- Georgetown County: Falls, Natural/Environmental, Struck-By, Transportation

A case could be made to include Calhoun County with Orangeburg County intervention rollout. Calhoun tied Fairfield at 21% high-risk with fewer injury events ahead of Beaufort and Georgetown shown in Table 17. Orangeburg and Calhoun are neighboring counties and for years have had an established history of collaborations often partnering as Orangeburg-Calhoun to better serve their citizens.

Overall, the state as a whole can reduce the number of ER visits for unintentional injury by focusing interventions on the top three injury types: Poisoning, Natural/Environmental, and Falls. The state Medicaid program, CHIP, selected private insurers, hospitals, and healthcare systems would greatly benefit from establishing collective partnerships with prevention organizations, pediatricians, parenting groups, policymakers and the South Carolina Department of Education. Such a collaboration could develop effective strategies and targeted interventions

to reduce unintentional injury rates and overall cost of care for children in South Carolina. Children's Trust of South Carolina would be the ideal partner since the organization currently has an established South Carolina Child Well-Being Coalition comprised of leaders committed to improving outcomes and opportunities to enhance child well-being for all children in South Carolina.

Summary

Childhood unintentional injury represents a substantial public health issue and a major economic burden for the state of South Carolina. Decreasing the burden of injuries should be a collective effort to save the lives of children in South Carolina. I would hope to use this research to establish a Childhood Injury Prevention Foundation in collaboration with MUSC Shawn Jenkins Children's Hospital and the Pearl Tourville Women's Pavilion and the Children's Trust of South Carolina dedicated to the prevention of childhood injuries. Children are our most vulnerable population; they deserve our protection and a chance at a long fulfilling life.

Appendix A.

Figure 7: Unintentional Injury ICD-10 E-codes used in data analysis

W65	X16	V86.63	T36.0X1	T40.0X1	T43.611	T46.8X1	T50.7X1	T56.0X1	T61.11	T63.691	W25	W35
W67	X17	V86.65	T36.1X1	T40.1X1	T43.621	T46.901	T50.8X1	T56.1X1	T61.771	T63.711	W26	W36
W69	X18	V86.66	T36.2X1	T40.2X1	T43.631	T46.991	T50.A11	T56.2X1	T61.781	T63.791	W27	W37
W73	X19	V86.69	T36.3X1	T40.3X1	T43.641	T47.0X1	T50.A21	T56.3X1	T61.8X1	T63.811	W32	W38
W74	V00	V86.73	T36.4X1	T40.4X1	T43.691	T47.1X1	T50.A91	T56.4X1	T61.91	T63.821	W33	W39
V90	V02	V86.75	T36.5X1	T40.5X1	T43.8X1	T47.2X1	T50.B11	T56.5X1	T62.0X1	T63.831	W34	W40
V92	V03	V86.76	T36.6X1	T40.601	T43.91	T47.3X1	T50.B91	T56.6X1	T62.1X1	T63.891	X50	W45
W00	V04	V86.79	T36.7X1	T40.691	T44.0X1	T47.4X1	T50.Z11	T56.7X1	T62.2X1	T63.91	W42	W46
W01	V09	V86.93	T36.8X1	T40.7X1	T44.1X1	T47.5X1	T50.Z91	T56.811	T62.8X1	T64.01	W53	W49
W03	V20-V29	V86.95	T36.91	T40.8X1	T44.2X1	T47.6X1	T50.901	T56.891	T62.91	T64.81	W54	W85
W04	V30-V39	V86.96	T37.0X1	T40.901	T44.3X1	T47.7X1	T50.911	T56.91	T63.001	T65.0X1	W55	W86
W05	V40-V49	V86.99	T37.1X1	T40.991	T44.4X1	T47.8X1	T50.991	T57.0X1	T63.011	T65.1X1	W56	W88
W06	V50-V59	V01	T37.2X1	T41.0X1	T44.5X1	T47.91	T51.0X1	T57.1X1	T63.021	T65.211	W57	W89
W07	V60-V69	V10	T37.3X1	T41.1X1	T44.6X1	T48.0X1	T51.1X1	T57.2X1	T63.031	T65.221	W58	W90
W08	V70-V79	V11	T37.4X1	T41.201	T44.7X1	T48.1X1	T51.2X1	T57.3X1	T63.041	T65.291	W59	
W09	V86	V12	T37.5X1	T41.291	T44.8X1	T48.201	T51.3X1	T57.8X1	T63.061	T65.3X1	W60	
W10	V86.03	V13	T37.8X1	T41.3X1	T44.901	T48.291	T51.8X1	T57.91	T63.071	T65.4X1	W61	
W11	V86.05	V14	T37.91	T41.41	T44.991	T48.3X1	T51.91	T58.01	T63.081	T65.5X1	W62	
W12	V86.06	V15	T38.0X1	T41.5X1	T45.0X1	T48.4X1	T52.0X1	T58.11	T63.091	T65.6X1	W64	
W13	V86.09	V16	T38.1X1	T42.0X1	T45.1X1	T48.5X1	T52.1X1	T58.2X1	T63.111	T65.811	W92	
W14	V86.13	V17	T38.2X1	T42.1X1	T45.2X1	T48.6X1	T52.3X1	T58.8X1	T63.121	T65.821	W93	
W15	V86.15	V18	T38.3X1	T42.2X1	T45.3X1	T48.901	T52.4X1	T58.91	T63.191	T65.831	W94	
W16	V86.16	V19	T38.4X1	T42.3X1	T45.4X1	T48.991	T52.8X1	T59.0X1	T63.2X1	T65.891	W99	
W17	V86.19	V80	T38.5X1	T42.4X1	T45.511	T49.0X1	T52.91	T59.1X1	T63.301	T65.91	X30	
W18	V86.23	V80	T38.6X1	T42.5X1	T45.521	T49.1X1	T53.0X1	T59.2X1	T63.311	T71.111	X31	
W19	V86.25	V81	T38.7X1	T42.6X1	T45.601	T49.2X1	T53.1X1	T59.3X1	T63.321	T71.121	X32	
X00	V86.26	V82	T38.801	T42.71	T45.611	T49.3X1	T53.2X1	T59.4X1	T63.331	T71.131	X34	
X01	V86.29	V83	T38.811	T42.8X1	T45.621	T49.4X1	T53.3X1	T59.5X1	T63.391	T71.141	X35	
X02	V86.33	V84	T38.891	T43.011	T45.691	T49.5X1	T53.4X1	T59.6X1	T63.411	T71.151	X36	
X03	V86.35	V85	T38.901	T43.021	T45.7X1	T49.6X1	T53.5X1	T59.7X1	T63.421	T71.161	X37	
X04	V86.36	V86	T38.991	T43.1X1	T45.8X1	T49.7X1	T53.6X1	T59.811	T63.431	T71.191	X38	
X05	V86.39	V87	T39.011	T43.201	T45.91	T49.8X1	T53.7X1	T59.891	T63.441	T71.221	X39	
X06	V86.43	V88	T39.091	T43.211	T46.0X1	T49.91	T53.91	T59.91	T63.451	T71.231	X52	
X08	V86.45	V89	T39.1X1	T43.221	T46.1X1	T50.0X1	T54.0X1	T60.1X1	T63.461	T71.29	X58	
X10	V86.46	V91	T39.2X1	T43.291	T46.2X1	T50.1X1	T54.1X1	T60.2X1	T63.481	W20	W23	
X11	V86.49	V93	T39.311	T43.3X1	T46.3X1	T50.2X1	T54.2X1	T60.3X1	T63.511	W21	W24	
X12	V86.53	V94	T39.391	T43.4X1	T46.4X1	T50.3X1	T54.3X1	T60.4X1	T63.591	W22	W28	
X13	V86.55	V95	T39.4X1	T43.501	T46.5X1	T50.4X1	T54.91	T60.8X1	T63.611	W50	W29	
X14	V86.56	V96	T39.8X1	T43.591	T46.6X1	T50.5X1	T55.0X1	T60.91	T63.621	W51	W30	
X15	V86.59	V99	T39.91	T43.601	T46.7X1	T50.6X1	T55.1X1	T61.01	T63.631	W52	W31	

Source: ICD-10 CM 2020, Practice Management Information Corporation (PMIC)

Appendix B.

Table 17. Counties Ranked by Population Rate Percent and Number of Injury Event

Highest Population Rate Percent (High-Risk)					Highest Number of Injury Events			
No.	**County**	**Population**	**N=Injury**	**%**	**County**	**Population**	**N=Injury**	**%**
1	Chester	7,244	2,901	40%	Beaufort	35,023	6,837	20%
2	Cherokee	13,140	5,184	39%	Orangeburg	19,044	5,664	30%
3	Orangeburg	19,044	5,664	30%	Cherokee	13,140	5,184	39%
4	Williamsburg	6,340	1,580	25%	Chester	7,244	2,901	40%
5	Fairfield	4,299	914	21%	Georgetown	11,438	1,781	16%
6	Calhoun	2,734	561	21%	Williamsburg	6,340	1,580	25%
7	Beaufort	35,023	6,837	20%	Horry	61,715	1,382	2%
8	Georgetown	11,438	1,781	16%	Richland	88,630	1,242	1%
9	Union	5,816	826	14%	Charleston	79,933	1,085	1%
10	Bamberg	2,724	340	12%	Spartanburg	72,501	1,040	1%
11	Hampton	4,116	456	11%	Greenville	118,364	1,015	1%
12	Jasper	5,889	472	8%	Fairfield	4,299	914	21%
13	Colleton	8,390	367	4%	Berkeley	52,749	828	2%
14	Barnwell	5,036	150	3%	Union	5,816	826	14%
15	Allendale	1,680	44	3%	Florence	32,590	723	2%
16	Marion	7,082	165	2%	York	66,495	722	1%
17	Lee	3,453	80	2%	Lexington	68,294	716	1%
18	Edgefield	4,894	113	2%	Dorchester	39,214	705	2%
19	Clarendon	6,479	148	2%	Calhoun	2,734	561	21%
20	Horry	61,715	1,382	2%	Pickens	23,712	530	2%
21	Pickens	23,712	530	2%	Jasper	5,889	472	8%
22	Florence	32,590	723	2%	Hampton	4,116	456	11%
23	Darlington	14,817	274	2%	Colleton	8,390	367	4%
24	Abbeville	4,924	91	2%	Bamberg	2,724	340	12%
25	Newberry	8,404	155	2%	Anderson	45,852	303	1%
26	Dorchester	39,214	705	2%	Darlington	14,817	274	2%
27	Greenwood	15,969	257	2%	Sumter	25,354	262	1%
28	Berkeley	52,749	828	2%	Greenwood	15,969	257	2%
29	Dillon	7,743	120	2%	Aiken	36,849	238	1%
30	Spartanburg	72,501	1,040	1%	Kershaw	15,167	198	1%
31	Richland	88,630	1,242	1%	Laurens	14,592	183	1%
32	Charleston	79,933	1,085	1%	Lancaster	20,786	175	1%
33	Kershaw	15,167	198	1%	Oconee	15,615	171	1%
34	Laurens	14,592	183	1%	Marion	7,082	165	2%
35	Oconee	15,615	171	1%	Newberry	8,404	155	2%
36	York	66,495	722	1%	Barnwell	5,036	150	3%

37	Chesterfield	10,032	106	1%		Clarendon	6,479	148	2%
38	Lexington	68,294	716	1%		Dillon	7,743	120	2%
39	Sumter	25,354	262	1%		Edgefield	4,894	113	2%
40	Greenville	118,364	1015	1%		Chesterfield	10,032	106	1%
41	Lancaster	20,786	175	1%		Abbeville	4,924	91	2%
42	Saluda	4,450	37	1%		Lee	3,453	80	2%
43	Marlboro	5,257	35	1%		Allendale	1,680	44	3%
44	Anderson	45,852	303	1%		Saluda	4,450	37	1%
45	Aiken	36,849	238	1%		Marlboro	5,257	35	1%
46	McCormick	1,116	7	1%		McCormick	1,116	7	1%

Source: https://datacenter.kidscount.org/data/customreports

Appendix C.

Table 18: South Carolina total population count for children under the age of 18 by race

Characteristic	**2016**	**2017**	**2018**	**Average**
Demographics: Race		**N (%)**		
Black	350,989 (32.%)	350,286 (32%)	348,814 (32%)	350,030 (32%)
Hispanic	99,703 (9%)	103,226 (9%)	106,353 (10%)	103,064 (9%)
White	622,043 (57%)	624,015 (57%)	624,039 (56%)	623,366 (57%)
Other	25,016 (2%)	25,903 (2%)	26,739 (2%)	25,886 (2%)

Source: https://datacenter.kidscount.org/data/customreports

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